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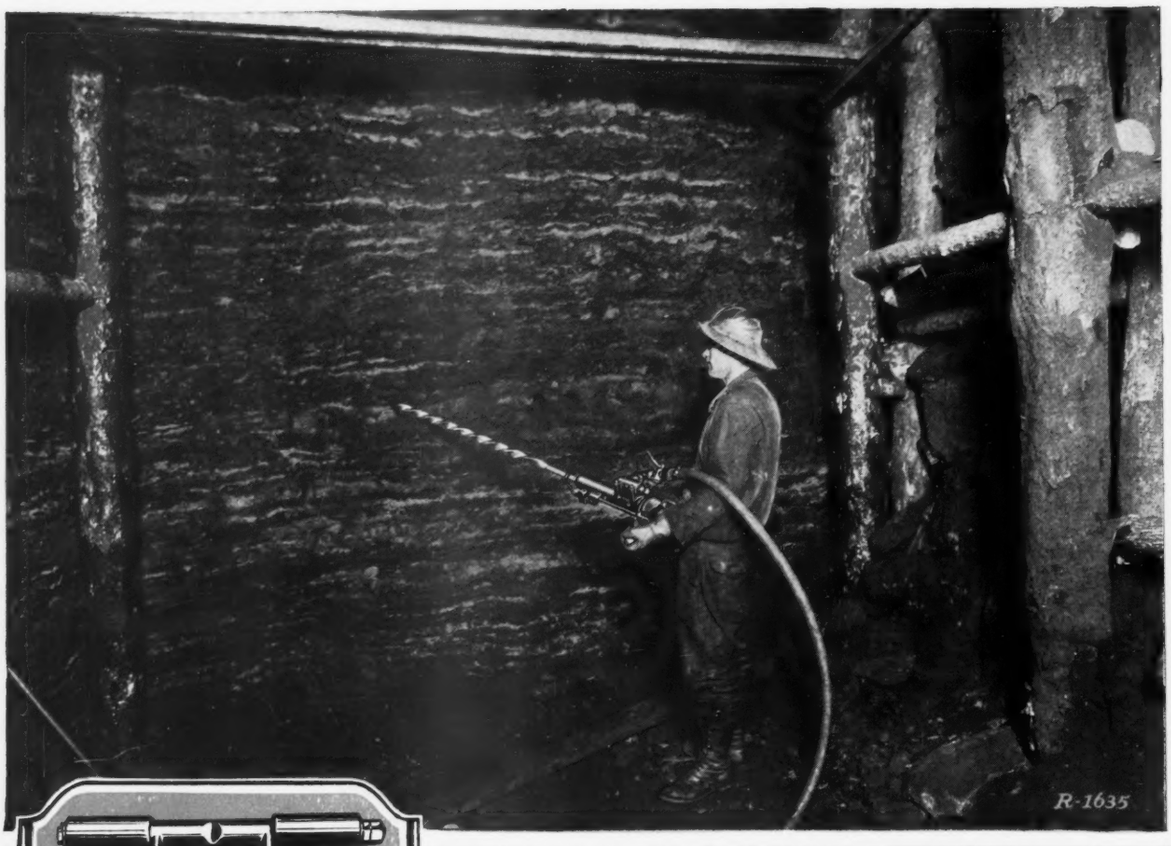

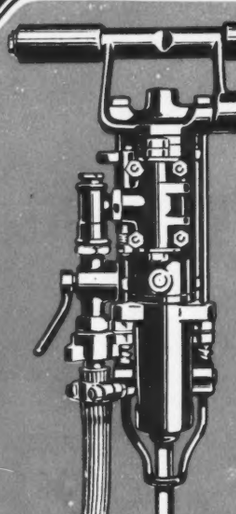

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ENGINEERING AND
MINING JOURNAL

McGraw-Hill Publishing Company, Inc.
JAMES H. MCGRAW, *President*

A. W. ALLEN,
Editor

VOLUME 125 — *New York, April 21, 1928* — NUMBER 16

The Physics of Percolation and Leaching Practice

A STUDY of the physics of leaching, especially by gravity percolation, involves consideration of several factors that have received little attention from metallurgists. Frequently, inspiration comes from an unexpected quarter, and when it comes from the U. S. Geological Survey it is usually worth more than passing attention. A recent paper by Miss N. D. Stearns on the physical properties of water-bearing materials is in this class. It prompts a query as to whether or not the water-supply engineer is ahead of the metallurgical engineer in a study of the fundamentals of flow rate and volume through crushed mineral. Definitions help to clarify the subject, even if they appear obvious. In this study, porosity is taken as the percentage of space not occupied by solid mineral matter in the total volume of the sample. The porosity of a mixed granular material depends largely on the degree of assortment and the manner of packing of the grains, as those experienced in leaching practice will readily admit.

A factor of considerable importance in the economics of leaching practice is the permeability of the mass. When such permeability falls below a certain minimum, a short-circuiting of the solution occurs, leading to contaminated effluents, if upward percolation be practiced, and decreased extraction. The determination of what constitutes minimum permeability with efficient and economical extraction of soluble by leaching is highly desirable. With this limit known, it is evident that, in those instances where the treatment of the maximum amount of fine material is desired, it is necessary to be able to learn promptly if the charge being sent to the leaching plant is of desirable proportions. Unfortunately, the coefficients quoted in the paper under consideration are complicated by the use of an archaic system of weights and measures. Nevertheless, the definitions are suggestive of parallel investigations in connection with metallurgical leaching.

The water-supply engineer has formulated as a coefficient of permeability "the rate of flow, in gallons per day, through 1 sq.ft. of cross-section, under a hydraulic gradient of 100 per cent, at a temperature of 60 deg. F." Mr. C. S. Slichter has defined a transmission constant as "the quantity of water, in cubic feet, transmitted in 1 min. through a cylinder 1 ft. long and 1 sq.ft. in section, under a difference in head at the ends of 1 ft. of water." To convert the transmission constant into a coefficient of permeability it is necessary, according to the bulletin, to multiply by 10,770. The entire problem, of course, can be simplified by the use of metric weights and measures and the Centigrade temperature scale. The metallurgist will realize the need, moreover, of adopting a column of a height corresponding to the height of the vat used in practice, although a factor may be applied to adjust the figures obtained by experimental treatment through a shallow depth of material.

Laboratory apparatus used for the determination of permeability, designed by Mr. O. E. Meinze, will be described in a forthcoming issue of *Engineering and Mining Journal*. It may suggest research and experimentation in the metallurgical field, to determine the scope for a cheap leaching process in the case of an ore that should be finely ground, but not slimed, to expose the metal or mineral to the action of a solvent solution. The opportunities for gravity leaching are not generally appreciated. Extremely fine sand is being treated successfully by this method, and excellent results are being obtained, from the economic as well as from the technical standpoint.

A New Copper Consolidation

THE pooling of interests in copper refining and marketing by the Nichols, Phelps Dodge, Calumet & Arizona, and New Cornelia companies is the latest step in the march toward consolidation to effect greater producing economy and more efficient marketing. The decision to erect an electrolytic refinery in the Southwest will not occasion a great deal of surprise, for rumors of such a step have been heard for several years. First it was the United Verde company that was named as the probable builder, the Los Angeles Chamber of Commerce becoming interested and seeking to bring the refinery to that neighborhood. A few months ago it was reported that Phelps Dodge had taken options on land at El Paso and one or two other places for a proposed refinery. The rapid industrial growth and population increase of the Pacific Coast, and low-cost power, have no doubt been important factors in the proposed step, as well as the possibility of making through shipments to foreign ports from Gulf or lower Pacific ports. To be sure, the Tacoma refinery of the American Smelting & Refining Company is well situated to supply the Coast and the Far East, but it is a sea voyage of close to 1,400 miles from Tacoma to southern California. Information as to the exact location of the proposed new refinery will be awaited with interest.

The three primary producing companies named in the merger recovered last year 153,000 tons of copper, 2,500,000 oz. of silver, and 90,000 oz. of gold, their blister having been refined in part by the American Smelting & Refining Company and in part by the Anaconda refinery at Perth Amboy. The new arrangement takes a substantial tonnage from these companies' refineries and gives it to Nichols, which will build and operate the new refinery in addition to the one now conducted at Laurel Hill, Long Island, N. Y. On the other hand, Nichols loses control of the sale of its own refinery production; and Anaconda must give up the disposal of the New Cornelia output, which it has heretofore

enjoyed. Phelps Dodge, which will be the selling agency for the group, heretofore sold its own copper, and also that of Calumet & Arizona.

The new arrangement is not likely greatly to affect the earnings of any of the companies directly involved, but it is a welcome step in the closer knitting together of the various factors in the copper industry.

Dust in Metallurgical Operations

OPPORTUNITY OFFERS for a general review of the field of dust and fume separation from air and furnace gases. The problem ranges from the simpler phases, such as suspensions of dust in dry crushing plants, to the complicated situation in the handling of a product of the quicksilver retort or the fume-laden gases from the metallurgical furnace. Crusher dust may be controlled by a vacuum, drawing air from crushing and screening apparatus to prevent release of dust in the plant. The separation of the coarser dust from the air is accomplished in dust chambers, by cyclones, by bag filters, and by water sprays or spray towers. In some instances Cottrell separators have been used. Although dust chambers and cyclones are effective in separating part of the dust, the finest escapes. Data for the design of dust retrieving apparatus are scattered, and experience with such apparatus should be published.

The smelters have bettered conditions by the use of Cottrell separators and baghouses, part of the fume being also recovered by settling chambers and flues. Reduction in temperature and conditioning appear to be necessary. The acidity of gases is neutralized by lime and other reagents. Progress has been made toward developing a filter that would be inert to acid gases and unaffected by high temperatures. The greatest advance appears to have been made by the smelters, but there is lack of published data. A general survey appears in Hofman's "General Metallurgy," and the subject is covered in less detail in Liddell's "Chemical Engineering." Numerous papers in the transactions of technical societies and other publications have appeared, but the opportunity for consistent generalization and a formularization of principles appears to have been neglected.

Modern "Fire-Setting"

VERILY the world does move, and at times apparently in cycles. Back we are for the moment at fire-setting, which was long accepted as a method of breaking ground before men learned to apply explosives for this purpose. The ancient procedure was to build a fire against the face, and, when the temperature of the rock had been raised sufficiently, to dash cold water against it, thereby causing the rock to crack and flake by the sudden tension thus produced. In South Africa, on the Rand, and in the New Modderfontein mine, in particular, this old idea has recently been revived in an interesting way. Experiments are being made there with a device, somewhat modified perhaps, that was developed for offensive purposes by the Germans during the recent war. This is the flame thrower, or *flammenwerfer,* so familiar that description is unnecessary.

The modification used, according to reports, resembles a giant blow-torch that uses paraffin for fuel and emits a flame 3 to 6 ft. long, 6 in. wide, and 1 in. thick at the point where it strikes the face. The temperature at this point is said to be 1,000 to 1,500 deg. C. The report says that the application of this device to breaking ground has been successful in Germany and some other European countries.

Judgment may well be reserved until details and results of tests have been received. The advantages claimed are that drilling and blasting are unnecessary and that dust is thus prevented. The latter point is of moment on the Rand, where much attention has been paid to the prevention of miner's phthisis. The obvious disadvantages are the risks and inconveniences attendant upon the production of such high temperatures underground; also the large amount of air consumed. This consumption of air, moreover, is equivalent to the production of a correspondingly large amount of gases of combustion, which must be taken care of. The method can hardly be considered, therefore, for stopes and headings where ventilation conditions are poor. Under special circumstances the balance may prove to be in its favor. For instance, ground that is exceptionally hard to drill may in some cases prove less refractory to "heat-treatment" of this sort. From the experiments in South Africa a method of breaking ground may develop that will be useful under certain definite conditions.

Adsorption of Moisture as an Interference in Weight Estimation

THE amazing properties of a solid in attracting moisture, and the tenacity with which such adsorbed moisture is held, are matters of concern to all interested in precision weighing. Dr. P. G. Nutting, in a recent issue of *Science,* drew attention to the difference in weight between a lump of gold and the same amount of the same metal after it had been rolled into sheet form. The only explanation possible is that the greater surface exposed permitted a correspondingly greater adsorption of moisture from the air. Other investigators have shown that such moisture is adsorbed with rapidity, whereas its release by heat proves a tedious process. It has also been shown that the amount adsorbed varies with the humidity of the atmosphere in which the adsorbent is placed.

It may be that attention to so precise a phase of weighing is unjustified, yet it would be interesting to learn if assayers have noted any eccentricities in result that might be attributed to this cause. The facts would seem to indicate that a gold-bullion prill, after parting and "igniting," should be kept in a dry atmosphere before weighing, or weighed at once. Under other conditions it would be interesting to know how much moisture might be adsorbed and to what extent the weight would be affected. Parted gold from an ordinary assay is often spongy, presenting a comparatively large surface. Would exposure to a damp atmosphere increase the weight to an extent vitiating the result? If, as has been proved, the removal of all adsorbed moisture from a solid phase is a difficult if not an impossible operation without the employment of extreme heat, what effect, if any, will fine grinding have on ordinary ore samples exposed to a humid atmosphere after the customary process of drying at 100 deg. C., or to a temperature at which the water of crystallization is not released? These and other questions of a similar nature may awaken interest in a subject of more than scientific import.

The Passing of the Rocky Mountain Club

A LAST ROUND-UP of members and guests of members of the Rocky Mountain Club took place at the Ritz-Carlton Hotel, New York, on April 11. The function, thanks to the organizing ability and enthusiasm of the secretary, Mr. Herbert Wall, was most successful. Moreover, it was unique, being at one and the same time a twenty-first anniversary and a wake.

Despite the high spirits in evidence at the gathering, it was impossible to "down" a sense of disappointment. The passing of the club, in itself, is perhaps of little consequence, but it was not a pleasant thought to realize that the curtain was to be rung down on opportunity for the comingling of Western men. Mr. Cornelius F. Kelley sensed this aspect of the matter in his speech; and among many of his listeners nothing but regret could arise from a knowledge of the fact the Rocky Mountain Club was to lose its individuality and scope for service. In these days much depends on good fellowship and personal contact. We recall to mind an address by a distinguished mining engineer in Los Angeles a few years ago. Speaking to a large gathering, he said: "I wish I knew you all personally, and intimately."

The Rocky Mountain Club was no grouping of mediocrities. Its president, Mr. John Hays Hammond, is a link with one of the greatest mining developments in the history of the world. His association with Cecil John Rhodes calls to mind the fact that he was one of the leaders of the reform movement in the Transvaal, 1895-96, and that after the Jameson raid he was sentenced to death.

It is inspiriting to come into personal contact with, and keep fresh the achievements of, those adventurous spirits who, in this country, have had so much to do with the development of Western mining, and, in consequence, national progress. With a touch of sadness, one must accept the fact that the last gathering of the members of the Rocky Mountain Club has been held.

What Are the Leading Domestic Industries?

THE RISE of the United States to a dominating position — industrially, financially, and politically—is undoubtedly the most significant trend in recent world affairs. A review of the present status of national wealth and income, of means and machinery that have been responsible, led Dean Dexter S. Kimball of the College of Engineering at Cornell University, during a recent session of the American Engineering Council, to name the three more important callings that have contributed to this result. With commendable sincerity, he placed engineering after agriculture and preventive medicine.

Perhaps the most discouraging aspect of the situation, he averred, is the widespread indifference of people at large to these changed conditions. The average citizen is pleased to enjoy the comforts of life that modern methods have brought him, but apparently gives but little thought to the difficult social and economic changes that appear to be inseparably associated with the production of these comforts. When the danger to his social organization becomes too apparent, he makes haste to "pass a law," often with little or no scientific inquiry as to reasons or results. An instance of this kind is seen in the Mississippi flood. For many years the hydraulic engineers have been advocating the establishment of a laboratory for the study of problems of this kind, on which it is evident that insufficient data are available to permit the formulation of a proper solution. The need for the careful basic study of the causes of such disasters cannot be overstressed.

Much of the trouble is due to the circumstance that the engineering groups have lagged behind other professional groups in presenting their case and keeping the public informed as to their ability and achievements. As a result, the public is beginning to believe that basic problems can best be solved by the politician, or the research laboratory, or the economist, or the colloid chemist.

Liquidation of Alaska Treadwell Group

IF CONSUMMATED the proposed sale of the properties and physical assets of the Alaska Treadwell, Alaska Mexican, and Alaska United Gold Mining companies to the Alaska Juneau Gold Mining Company, will mark the final stage in the liquidation of these once well-known mines, which were profitably operated over a long period of years and were in the full vigor of production when on April 21, 1917, following a surface subsidence, the waters of the near-by Gastineau Channel flooded the workings.

The Alaska Treadwell mines were noted for steady production and as initiating a new era in the profitable exploitation of a low-grade gold ore. Under the direction of Mr. F. W. Bradley they achieved a reputation for efficiency, the application of novel methods, and low-cost operation. They were profitable mines, and the success achieved was a potent influence in stimulating interest in low-grade ore deposits. As a result, mining engineers and financial interests were encouraged to organize companies and operate properties that, owing to the low grade of the ores involved, would not have been worked at the time had it not been that the way was shown. Large-scale mining operation on a great deposit of low-grade ore, based upon sound engineering, the design and selection of suitable mechanical equipment, and systematized operation, was made a success and thus became a part of standard mining practice. Two important factors in such exploitation are competent direction and the availability of appropriate and up-to-date mechanical equipment. The parts played by power and mechanism are frequently overlooked. Nevertheless, they dominate the present-day situation in respect to low-grade deposits.

It is also worthy of note that the stockholders of the Alaska Treadwell group are to be scrupulously safeguarded, their interest being transferred largely to the Treadwell Yukon Company, Ltd., and in part to the protection of the Alaska Juneau Gold Mining Company, both operating companies. Alaska Juneau, in spite of several limiting economic conditions, has been placed on a profit-earning basis. Treadwell-Yukon has acquired a property of great importance in the Sudbury district of Ontario, is making a substantial profit from its Mayo operations in the Yukon territory, and is developing a promising property in the Tybo district of Nevada. The mining interests of the stockholders therefore will be preserved, and the assets realizable in their holdings in Alaska will be put to work in other properties.

MINING GRECIAN

By J. R. THOENEN
U. S. Bureau of Mines, Washington, D. C.

Crude hand methods still used —American mining engineer finds many strange conditions

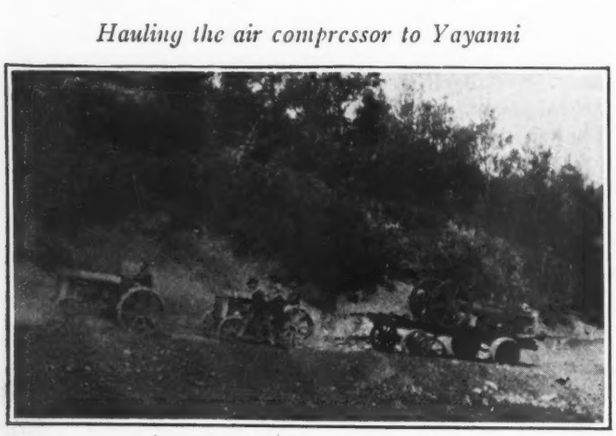
Women cobbing magnesite

HIGH-GRADE magnesite has been mined for many years on the island of Eubœa, off the east coast of the Greek mainland. Some has been shipped to the United States in the crude state, but most of it finds its way to European markets for calcination. Unlike the Austrian ores, Greek magnesite generally contains insufficient iron for dead burning, and therefore is a better raw material for caustic magnesite as used for Sorel cements. The ore is also notably free from lime, many deposits showing less than 2 per cent.

Crossing the island of Eubœa from Montudi to Limni, east and west, is a band of serpentine rocks roughly 15 miles long and 6 to 9 miles wide, with some unconnected outlying areas. No magnesite has been found except within the serpentine. The veins vary in size from the thickness of a pencil to several meters in width. Dips vary from horizontal to vertical, and deposits range from large massive lenticular bodies following lines of structural weakness to a network of small vein systems.

Most writers think these veins have been formed by the alteration of the serpentine by descending carbonic waters, but my own observations indicate that such a theory does not tell the whole story[1]. For various good reasons I am inclined to a theory of at least partial magmatic origin. In January, 1927, I was engaged to make an examination of the properties leased by the Magnesia Cement & Carbonic Gas Company, comprising four concessions lying on one of the outlying serpentine occurrences and known as the Mourtia, Miemeti, and Tripeti, and No. 106. They cover about 5,000 acres and lie about 10 miles north of the main serpentine belt. The Mourtia and Tripeti concessions are contiguous and border on the Aegean Sea near the bay of Mourtia; the Miemeti concession lies inland from them. No. 106 is a long, irregularly shaped concession covering portions of the other three and some of the intervening land between Miemeti and the other two.

Hauling the air compressor to Yayanni

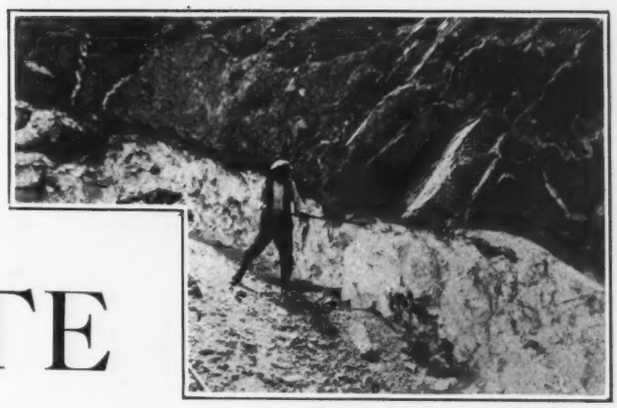


The country is mountainous, with elevations up to 2,500 ft. Much of the surface is farm land under cultivation; other portions contain burned timber land. Although badly eroded, only one permanent stream exists on the concessions, though there are numerous springs of excellent drinking water. The surface is drained through subterranean watercourses emptying into the Aegean. The climate is similar to that of Florida, with no frost along the seashore, but with snow on the mountains in winter. For several months during the winter a day without rain is unusual, although the opposite is true during the summer.

Mining operations have been confined to the Mourtia concession, although some development has been carried on at Miemeti. Only a small amount of surface trenching has been done on Tripeti. At Mourtia proper (Mourtia Bay) early development and mining has been done on the vein systems outcropping in the eastern headland of Mourtia Bay. These veins are narrow, and the

[1]Thoenen, J. R.: "Notes on the Genesis of Grecian Magnesite." Paper before the A.I.M.E., Feb., 1928, meeting.

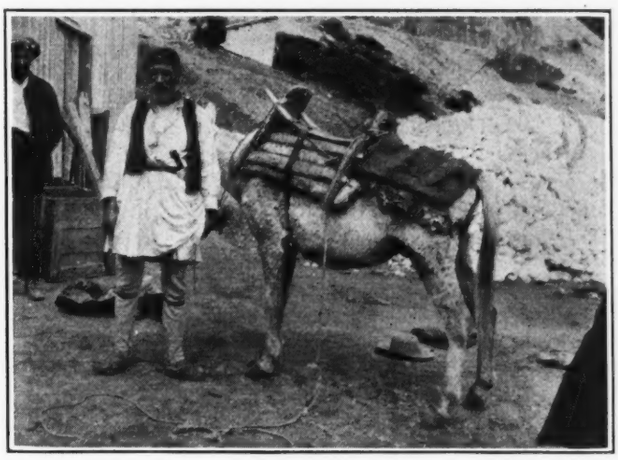
work consisted of driving simple adits or drifts. A short distance back from the shore line stoping was done on one vein, and several hundred tons of ore of a peculiar pinkish tint was removed. Analysis showed it to contain too high a percentage of iron for caustic magnesia, although it forms an excellent material for dead burning. This is unusual for Grecian magnesite.



Vein of high-grade magnesite on Lefko Island

MAGNESITE

This early method of mining consisted of driving a haulage drift in the vein along the strike. From this, breast stopes were carried up the dip, leaving pillars at irregular intervals. The dip (35 deg.) was too flat to allow the ore to move by gravity to the cars below, and hence necessitated shoveling and scraping. This was done by hand, a native tool called a "tsopa" being employed—a round-pointed shovel bent at right angles, fitted with a straight wooden handle, and manipulated like a garden hoe. When scraped to the haulage drift



The beast of burden. Note unusual saddle and peasant costume.

the ore was shoveled into cars and hauled by mules along a roadway cut into the side of the hill to a point above the beach. Here it was dumped into crude pole chutes and thus conveyed to the shore for sorting and cleaning.

The Yayanni mine, the principal opening on the Mourtia concession, lies about one kilometer back from the shore and about 300 ft. above sea level. It was also opened prior to my arrival by driving four adits horizontally into the side of the hill on different outcrops. These, as shown by early reports, were considered to be all on one vein; but subsequent operations proved the existence of two and possibly three distinct veins. The No. 8, or most northerly, opening was also the highest on the side of the mountain and followed a vein which could be traced for for some distance on the surface. This vein dips approximately 35 deg. to the southwest and averages one meter thick.

The original method of mining was to drive the haulage level along the strike and breast-stope upward, as at Mourtia, leaving pillars where necessary. In some places crude chutes were built into the haulageway and the ore was scraped into cars spotted below them. All mining was done by hand, which necessitated the removal of barren rock to provide head room in which the miners could stand erect. The method of drilling holes was the accepted practice in Greek mines. As it is somewhat different from American methods, it may warrant description. A single-jack hammer with $\frac{3}{4}$-in. solid octagon drill steel is used. Unlike our single-jack, the hammer is arc shaped, double headed, and fitted with a wooden handle about 1 ft. long. It weighs about 8 lb. To the handle near the hammer is fastened a cloth or cord loop. The miner first puts his hand through this loop and then grasps the handle near its extremity.

About 75 per cent of the holes are drilled as uppers, the miner holding the steel in one hand and striking upward with a swinging motion from below the waist. His grasp of the handle is merely to guide the blow, the loop around his wrist carrying the weight. Where it is impossible to drill holes upward, and thus allow the cuttings to run out by gravity, they are drilled vertically downward with an overhand blow as we do, using water. The miners claim these holes are much harder to drill and also much slower. This is probably because of the extra effort necessary in raising the weight of the hammer in the overhand strike. Lack of water in the mines and the necessity for packing all drilling water in small kegs or barrels on the back of burros is probably a further contributing reason for dislike of this method of drilling.

In advancing drift headings, the same method of drill-

Drifting. Note the upper holes and the single-jack.

ing was used; but as the holes were all short (seldom over 2½ ft.), no regular system of drill rounds could be employed. However, the miners proved adept at placing their holes so as to take best advantage of the inequalities

The headquarters camp tent

of the face and get a fair tonnage per pound of explosive used.

As previously mentioned, this method of drilling necessitated the removal of considerable barren ground to provide headroom, thus automatically increasing mining costs. To obviate this, a system of breast stoping followed by waste filling was adopted, which proved more economical. In this system the same hand-drilling methods were employed, but the ore was sorted in the stopes and the waste piled behind the miners. At the 35 deg. inclination it was not difficult to pack this material from footwall to hanging wall. Stull timbers were placed and kept close to the advancing face, and poles or lagging spiked to them. As the face was advanced upward in the shape of an inverted V, with its apex at the top (saw-tooth stoping), these lines of stulls and lagging provided convenient chutes down which the good ore was passed to the level below, and they also formed retaining walls behind which the waste was held in place. As the face advanced, the stulls and lagging were removed and set ahead a section at a time. In this manner no ore was left in pillars, and 75 per cent of the timber was recovered. Open stopes were filled, and the miners were at all times working in narrow spaces offering a minimum of danger from caving ground.

Drifts 7A and 7B were originally opened on what was thought to be an extension of No. 8 vein. Here the ore lies nearly horizontal (dip 5 deg.). The same method of breast stoping had been followed, and attempt had been made to pile waste material in unused portions of the stopes. The method finally adopted was to advance parallel drifts on 10-meter centers, leaving alternating pillars between them. This allowed a minimum of shoveling distance to the cars and at the same time gave plenty of room for back filling. Timbers put in to retain the filling were not recovered. Ore left in pillars, however, could be recovered as the mine was worked out by retreating. Each alternate pillar, breasting as it did on the haulage drift, could be entered and robbed without rehandling the waste filling.

To the southwest of Drift 7B, the ore abruptly dipped at an angle of 17 deg. and became much thicker. This necessitated mining down the dip. Lack of mechanical power available for hoisting presented quite a problem. Owing to the surface topography, no drift at a lower level could be driven economically to this ore. It was therefore decided to sink winzes and develop it if possible to a point that would warrant devising a method of attack from below. Accordingly, a steel cable was fastened to the hanging wall at the bottom of the winze and in the roof of the haulage drift. On this an iron sheave was fixed, from which were suspended two iron hooks. Native wicker baskets holding about 40 lb. of ore were obtained and loaded by hand or shovel. They were then hung on the hooks, and a boy or man on the level above pulled them up till he could dump them into the cars. The method was crude, but it worked well enough for us to prospect the ground below the drift and develop a large tonnage of high-grade ore.

No. 9 drift was driven parallel to Nos. 8, 7A, and 7B, but a short distance southwest and at a slightly higher elevation. This vein was found to parallel the southwest dip of that in 7A and 7B, and subsequent workings proved it to lie about 4 meters above it. Here the method devised for No. 8 was again tried and successfully worked up the dip. No attempt was made to work downward.

As the ore was recovered from these various openings it was trammed by hand to the portals and dumped down the side of the hill, where women and boys collected and sorted it. Clean pieces were carried directly to the storage piles, those requiring cobbing being placed in piles for the cleaners. The women sat on the ground under improvised sunshades and cobbed the ore by chipping with small hand hammers and steel brushes. After cleaning, the ore was hauled by two-wheeled carts to the beach at Mourtia Bay, 1½ kilometers distant, for storage and shipment. Shipment is effected by loading from stock by hand to cars, tramming to the pier, and dumping into small lighters, which are then towed to the side of the ship. The ore is hand-loaded into steel buckets, hoisted by the ship's windlass, and dumped into the hold.

Although the description shows magnesite mining in Eubœa to be extremely crude, as applied to the smaller operations, some of the larger operators have installed modern air compressors and rock drills, with rope tram-

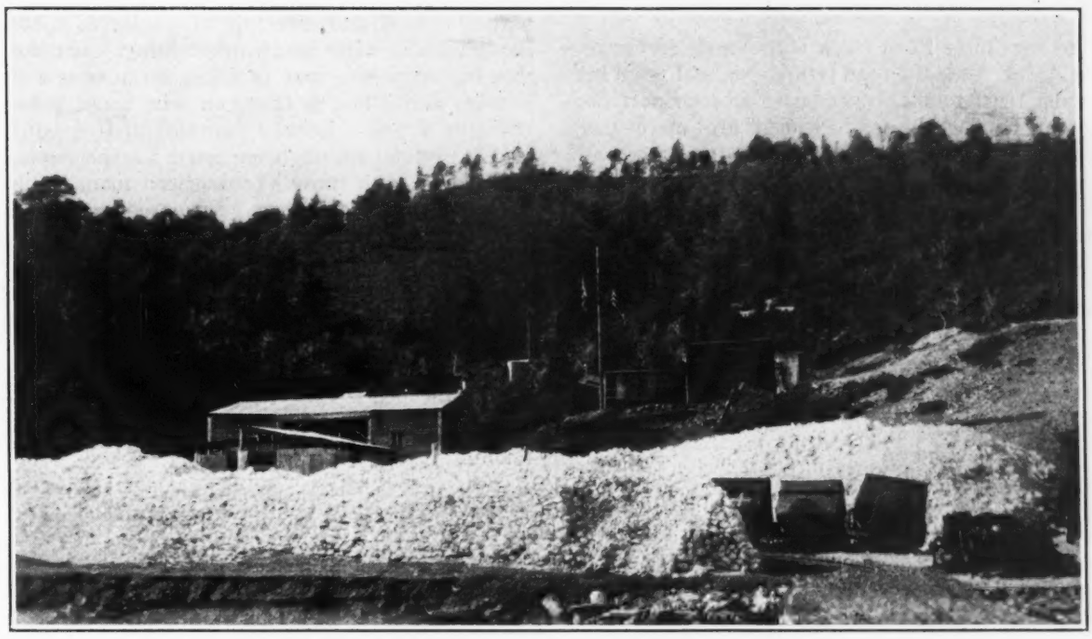
Yayanni, looking northeast. Adit 7A left center over trestle. No. 9 at extreme right

ways for transportation from outlying mines to seaboard. The rock drill seems to have a hard time getting firmly established, however. One firm abandoned it while I was there. Various reasons were reported, but probably the

real one was a combination of the difficulty of overcoming the native custom of hand drilling and the high cost of fuel for power purposes. These methods applied to a low-priced ore such as magnesite would be economically out of the question in this country, but it must be remembered that the local wage scale and the standard of living are much below ours. Miners are paid from 50 to 60 drachmas (62½ to 87½c.) per day of eight hours. Common labor, 40 drachmas (50c.); and women, 22 drachmas (27½c.); and they work ten hours for it. Men and women will walk as much as five miles to and from work to earn this wage. Consequently labor-saving devices in Greece do not have the same economic value that they have here.

material from which it was made! Such annoyances never reach serious proportions, and the officials, though firm in the discharge of their duties, are seldom disagreeable.

As is usual in operations in foreign countries, the American engineer is handicapped by lack of knowledge of the local language. It is a regrettable fact that the study of foreign languages seems to be taboo in the curriculum of the American mining college. Some of our colleges do teach Greek, but it is ancient Greek and not the present spoken language. Armed with a working knowledge of college Greek, a foreigner would have great difficulty in making himself understood among other than scientists or possibly lawyers in Greece today.



Cobbed and sorted magnesite ready for shipment

With all the handicaps noted, cleaned magnesite ore can be mined and delivered on board steamers for between $2.50 and $5 per ton, depending on the length of land transportation.

All growing timber in Greece is owned and controlled by the government, except where it has sold cutting rights to private operators. Thus, although an operator might own a mining lease on a concession, he does not own, nor can he use, the timber thereon. This condition holds even to down and dry timber killed by forest fires. It is even illegal to go afield and gather dry firewood in burned-over areas.

In this connection it might be interesting to note that with no local coal, and imported coal expensive because of transportation charges, we followed the local custom and used charcoal for blacksmith forges and other work. To do so we had to formally apply for (and pay for) permission to make our own charcoal. This was done; and one man, delegated as our official charcoal burner, collected pine knots and roots and burnt them. Some months after we had been operating thus, having paid for and obtained permission to do so, we were summarily hailed into court and fined for not having obtained permission to collect pine knots and roots from which to make our charcoal. Apparently we had obtained permission only to make the char and not to collect the

As languages differ, so also do customs. The Greeks, suppressed and dominated for centuries by despotic Turkish rule, and at best the football for stronger nations, have been forced to live largely by their wits. Finding treachery and deceit on all sides, they have learned to trust no one. One is surprised to find the peasant Greek friendly, capable, of average intelligence, and not afraid of work. I have found him a hard man with whom to drive a bargain, but once it is made and fully understood he will carry out his part, win or lose. However, one must be careful that a full and complete prior understanding is had on both sides. With this in mind I had no difficulty in allotting drifting contracts on a footage basis. Many Greeks have spent some time in America and many speak English. Nationally and individually they are friendly toward Americans, and American capital in Greece will find itself in great preference to that of other countries.

Transportation is the outstanding difficulty. In going to Mourtia one travels by train from Athens to Chalkis, the capital of Eubœa. From here to Aghia Anna (St. Anne) the federal government has recently completed an automobile highway over the mountains. The distance is 52 kilometers (32 miles), and in this distance two mountain ranges are crossed, the road reaching a maximum elevation of 1,500 meters (4,900 ft.) above sea

The customary milk and meat supply

level. The inevitable Ford truck is the mode of conveyance. At Aghia Anna the road terminates, and from here on one must trust to the lowly burro to transport both himself and his belongings. Roads are mere trails through the hills and valley. They cross and recross in so confusing a manner that one must make a trip several times before feeling safe without a guide. This distance, fortunately, is short (9 miles); or, as the Greek calculates it, three hours. If one leaves Athens by the early train (7 a.m.) he will reach Chalkis at 10. Then, by hiring a special auto (regular buses do not leave until afternoon), he can make Aghia Anna by 2 p.m., and if lucky in getting his burros quickly he can reach Mourtia by 6. Altogether, he has traveled probably 100 miles. However, I have spent as much as ten hours on the trip from Chalkis to Aghia Anna alone. Time means nothing to the average Greek. What he cannot do today he can do tomorrow; so why worry?

Heavy machinery and mine supplies can be brought in by sea, by chartering a local "felucca" (a small sailing vessel) from Volo to the north or Pireaus to the south. Freight rates are low, but deliveries are dependent on the wind. Occasionally one can charter a boat with an auxiliary gasoline engine and get quicker service, except in winter. The Aegean is noted for its so-called "white squalls," which arise almost instantaneously and apparently from nowhere. They whip up a sea, dangerous to all but large steamers.

Lack of dependable explosives is also a handicap at first. Greek law does not require the labeling of cases with the kind and strength of explosive content. Although I did, after much questioning, elicit the opinion that our explosive was probably an ammonia dynamite, I never could find a salesman who could tell me what strength it was. Locally manufactured dynamite is of inferior grade, although imported French explosives are comparable with those of American manufacture. The same is true of detonators. When using those of Greek make it was always a gamble whether our shots would go or not. French caps (No. 7) are easily procured, however, and are good. I saw no double-taped or waterproof fuse, although I was told it could be purchased.

The malaria mosquito is rampant in the valleys during the summer, requiring the constant use of quinine; and the Asiatic flea is everywhere—winter or summer.

Use of Noble Metals for Electrical Contacts

ONE OF the well-known and important uses of the noble or precious metals has been for electrical contacts, according to a paper presented by E. F. Kingsbury at the recent New York meeting of the A.I.M.E. In fact, the elements of this group, comprising gold, silver, and the six platinum metals, have been called "noble" because of their ability to resist heat and corrosion, properties which were early found to be of importance in good contacts. Of these, platinum and its iridium alloys, palladium, and silver have been extensively used. In recent years the electrical industry has been responsible for about one-eighth of the total consumption of the platinum metals in the United States.

During the last twenty years a considerable number of contact alloys have been proposed in the patent literature, largely with the aim of more or less replacing platinum by gold and silver, and some of these alloys are finding increasingly widespread application as the reliability of their performance becomes established. From even the partial data at hand it appears that this substitution by the less precious metals has replaced at least one-half of the amount of platinum used in the electrical industry.

Though the subject is of considerable interest to the metallurgist, it is even more so to the electrical engineer, and it is surprising that the literature records no systematic and comprehensive investigation or research as to the possibilities of the applications noted. Practically all the scattered work on noble metal contacts has centered around platinum as a standard and has had two more or less distinct aims. One of these has been the replacement of platinum by cheaper materials, and the other the development of materials of superior electrical performance. The merit of a contact metal has been assumed to be dependent on its infusibility, and since the more precious metals have the higher melting points, there has naturally been an association of the two qualities in the sense that the more precious were supposed to be of superior performance. This belief, combined with a lack of understanding of the electrical requirements, has undoubtedly retarded the widespread application of the less precious alloys.

In spite of this condition, however, the use of cheaper platinum substitutes for contacts, as for other technical applications, has been forced by the economic situation. The instability of the market price of platinum, uncertainty regarding its supply, and the increasing demand have furnished strong incentives to experiment with substitutes. Although at present the price of platinum is declining and the production is increasing, it is unlikely that the use of substitutes will be diminished, especially as these substitutes are superior to platinum.

There are on the market several alloys of the platinum metals that are used because they are superior to platinum in melting point and hardness and there are certain types of circuits and conditions where they are demanded, regardless of cost, because of their increased resistance to erosion. Probably the most extensively used of this class are the alloys of platinum with iridium. There are several of these in use up to about 25 per cent iridium. As the cost increases with the iridium content, the percentage is ordinarily limited approximately to the demands of the circuit. An alloy of platinum, iridium, and rhodium has been found to give superior performance to the platinum-iridium series.

Noranda's New Smelter Stack

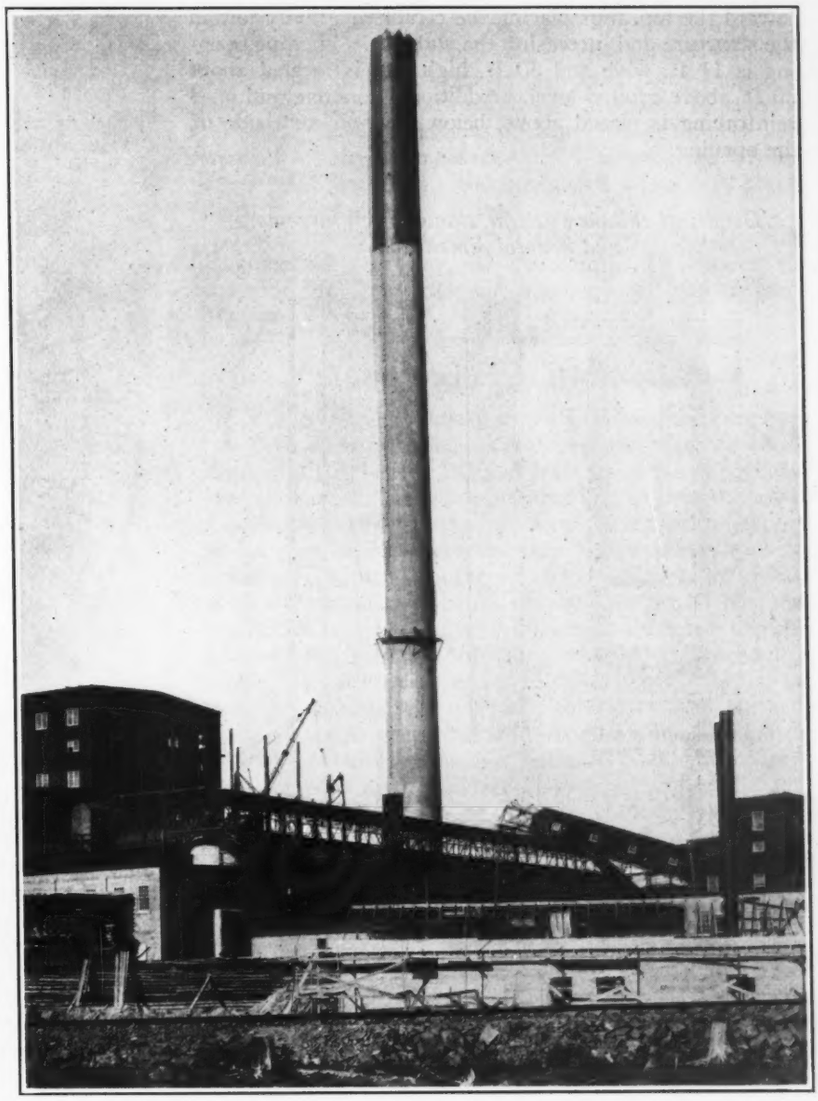
Tallest Reinforced-Concrete Chimney in America

By E. H. MacDermott

Chimney Engineer,

The Rust Engineering Company,

Pittsburgh, Pa.



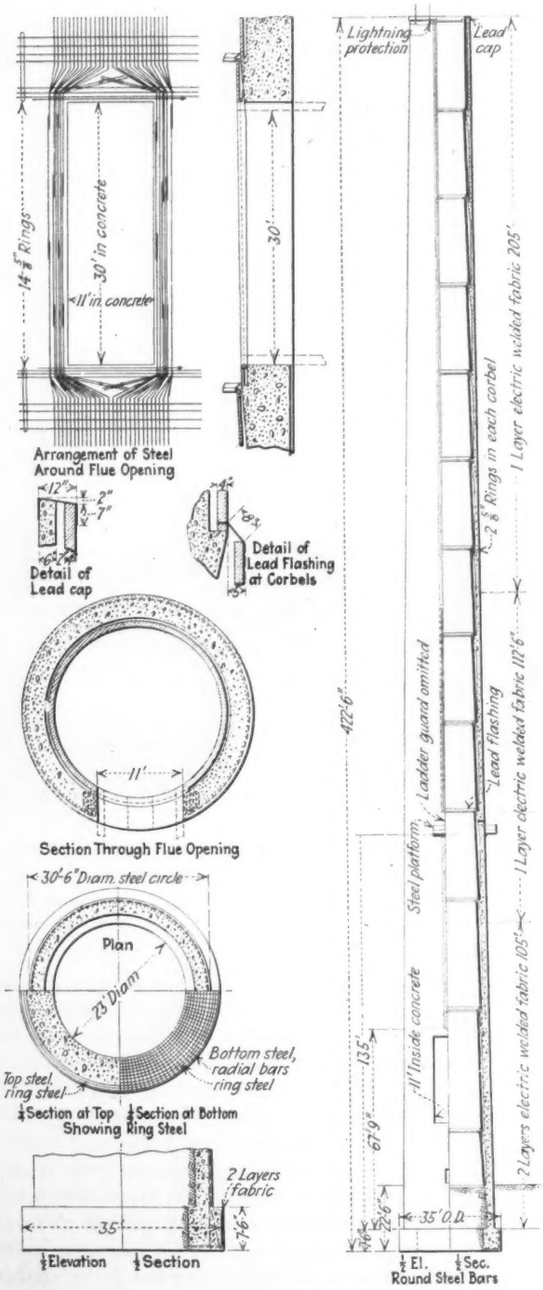
Stack, Cottrell treaters, and flues at the new smelter of the Horne Copper Corporation at Noranda, Quebec

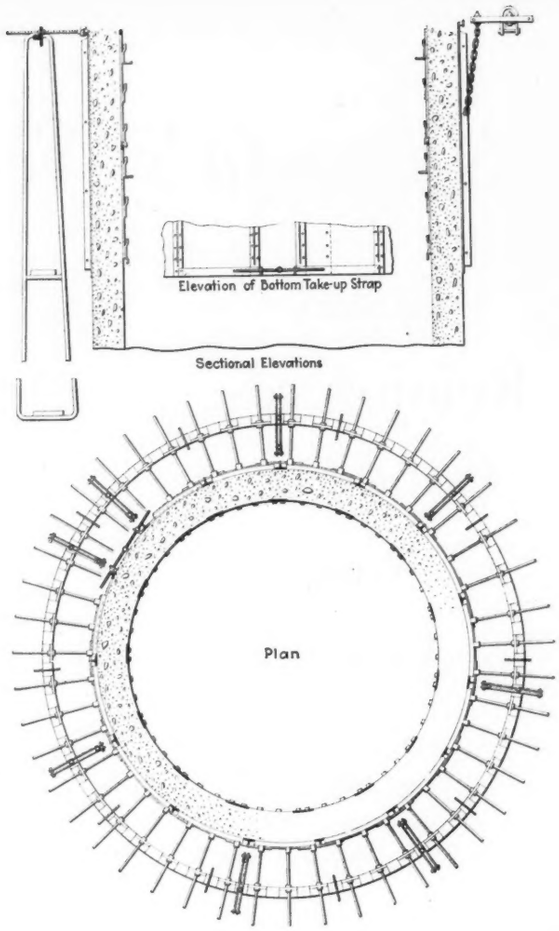
THE tallest reinforced-concrete chimney on the American continent was erected in 1927 at the plant of the Horne Copper Corporation, Noranda, Rouyn district, Canada. It is 422 ft. 6 in. high from the base to the top of the shaft, and 18 ft. in diameter inside the lining at the top. This height exceeds by 13 ft. 6 in. the previous record height of 409 ft. of two reinforced-concrete chimneys built by the same designers and erectors at Trail, British Columbia, in 1924 and 1925. The base of the chimney, 883 ft. above sea level, is supported on a foundation of solid rock. The chimney, which is a unit of the copper-smelting plant, produces draft for and carries off dust and gases from four roasting and two reverberatory furnaces and two converters. Before reaching the chimney the gases pass through a Cottrell dust collector. The stack is designed for a capacity of 550,000 cu.ft. of gas per minute at temperatures from 300 to 450 deg. F. Outside temperature ranges from —40 to +90 deg. F. Draft at the base is from $1\frac{1}{4}$ to $1\frac{1}{2}$ in. water column. The shaft is designed to withstand the effects of acidic gases within and the combined loadings resulting from its own dead weight and a horizontal wind pressure of 25 lb. per square foot of projected area. Its base consists of a concrete ring 7 ft. 6 in. deep, 35 ft. outside diameter and 23 ft. inside diameter, reinforced in the top and bottom with rings of 1-in. steel bars and with $\frac{3}{4}$-in. bars arranged radially. The shaft is connected to the base by means of 206 1-in. steel dowels, which start with hooks securely fastened under the bottom steel of the base and project upward into the shell a sufficient distance to provide ample bond between the dowels and the concrete. Half the bars project 4 ft. and the other half 11 ft. 6 in. The shell is reinforced with vertical and horizontal steel; the former takes care of tension stresses resulting from the wind load and vertical expansion from temperature changes. The total area of steel required at various sections is computed and a number of bars are selected to meet the necessary conditions, and not to be spaced at

too great a distance. To meet these conditions in this chimney, the number of bars varies from 206 1-in. rods at the base to 57 ½-in. rods at the top. The horizontal steel withstands all circumferential tension arising from temperature variations in the chimney wall. It consists of electrically welded rectangular wire fabric, with rods spaced 3 in. vertically and 16 in. horizontally.

To distribute the weight of the chimney properly, the wall is made heavy at the bottom, decreasing in thickness toward the top, thus placing the center of gravity low in the structure and increasing the stability. The flue opening is 11 ft. wide and 30 ft. high and is located about 20 ft. above ground level. Additional concrete and steel reinforcing is placed above, below, and on each side of the opening.

Details of chimney design, showing reinforcement, and general dimensions





Arrangement of forms used in the construction of the chimney

The chimney is lined for its entire height with 4-in. acid-resisting vitreous brick, laid in special acid-proof mortar and built in 45-ft. sections supported on ledges extending inward from the concrete shell. An air space of about 2 in. is maintained between the lining and concrete shaft; and at the junction between the sections of lining, a lead flashing is installed to protect the joint. A lead coping covers the top of the lining, air space, and shaft. As protection against gases, the top 100 ft. of the outside and the entire inside of the concrete wall is covered with a specially prepared acid-resisting bitumastic paint.

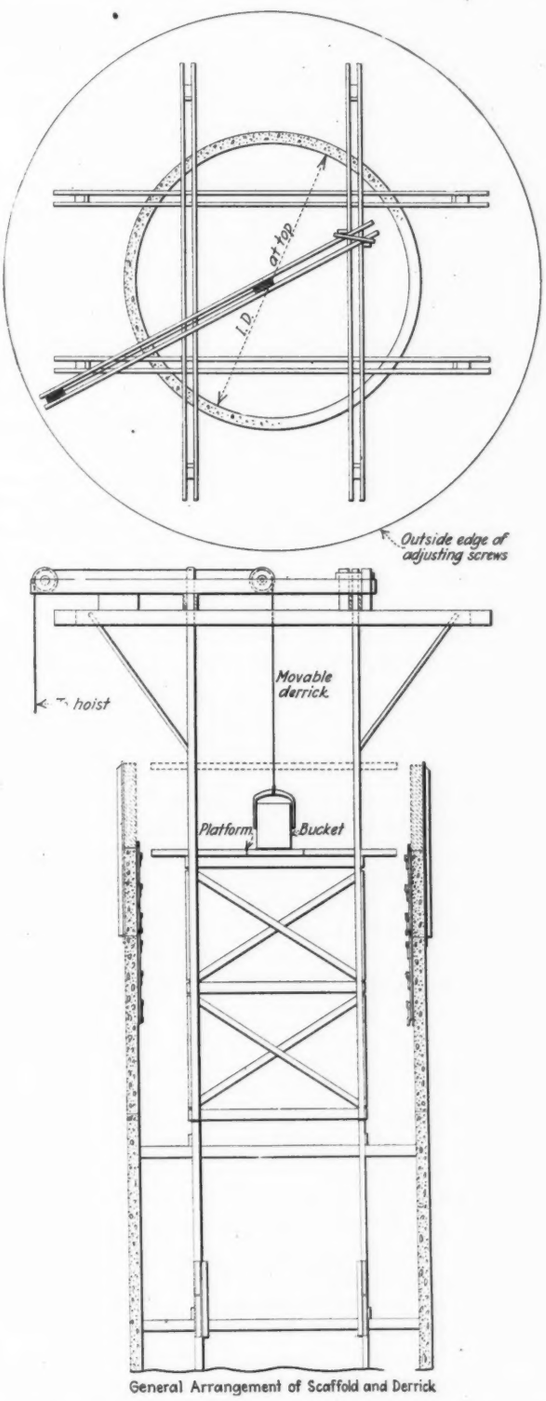
The concrete mixture for the base of the chimney consisted of one part cement, two parts sand, and four parts gravel. The mix for the remainder of the shaft consisted of one part cement, two parts sand, and three parts gravel; and the consistence of the mix was carefully regulated to secure a uniform quality of concrete. An average slump of 6 in. was maintained. The coarse aggregate was high-quality washed and screened gravel, graded in size from ½ in. to 1¼ in. Fine aggregate consisted of washed and screened sand ranging in size to particles passing a 4-mesh screen.

At a level 120 ft. from the ground a steel platform was installed to extend around one-fourth the circumference of the shell. This is used as an observation platform, from which readings and samples of gases are taken through openings in the chimney. It is reached by way of a steel-guarded ladder that extends the entire

height of the shaft above the top of the breeching. The top 50 ft. of the ladder is coated with $\frac{1}{16}$-in. lead to protect it from acid fumes.

The contractor's special sectional all-steel forms were used in the construction of the concrete shell. The forms consist of internal and external segments, adjustable to any wall thickness or diameter. A scaffold is suspended from the outside of the forms for the use of workmen in making adjustments and finishing the concrete surface. A wooden scaffold was erected inside the chimney as work progressed; this supported a special "cat head," consisting of four crossed timber beams. From these the forms were suspended, and above them was arranged a derrick arm, from which the hoisting cables extended down the inside to the concrete loading platform and down the outside to the hoisting engine.

Scaffold and derrick used in the construction work



General Arrangement of Scaffold and Derrick

Lightning protection consisted of twelve points attached to the top of the shaft and grounded by means of two copper cables terminating in plates set in permanently moist earth. The top 50 ft. of the system was coated with $\frac{1}{16}$-in. lead. A large cast-iron door at the base provides access to the lower portion of the chimney.

Construction operations began in April, 1927, and were completed in 162 days. Noranda being located at about 49 deg. north latitude, it was necessary to schedule the work during the season when no extremely cold weather would be encountered. The program worked out so well that the job was completed a few days before the first cold weather arrived.

The chimney was designed and erected by The Rust Engineering Company, of Pittsburgh, Pa., under the direction of Eric Plagwit, manager of the chimney division.

Stone Industry in Sweden

THE STONE industry in the Goteborg district, Sweden, was operating under more satisfactory conditions in 1927 than in 1926, at least so far as exportation was concerned, according to the U. S. Department of Commerce. Preliminary figures indicate that the exports in October and November were higher than those for the corresponding months of 1926; although there have been numerous complaints of the low prices obtained, attributed to illegal competition and wasteful working methods on the part of some of the quarry owners. Complaints are made chiefly against foreign firms, but criticism of wasteful methods, such as taking out only the most easily accessible stone and then abandoning the quarry, is also made against Swedish co-operative societies and individual producers.

Inspiration Consolidated Copper Company Concentration Statistics for 1927

	1927	1922
Tons of ore milled	2,131,590	3,667,495
Average per day of milling operations, tons	6,306.5	11,437
Average number of sections running	6.5	12
Average rate per section, tons	964	954
Screen analysis of mill feed to concentrating machines (on 48 mesh) per cent	1.9	4.2
Assay of mill feed (copper) per cent	1.147	1.228
Oxide copper in mill feed, per cent	0.224	0.210
Assay of general mill tailings (copper) per cent	0.274	0.272
Oxide copper in general mill tailings, per cent	0.206	0.187
Smelter assay of concentrates produced (copper) per cent	37.229	26.213
Assay of flotation concentrates (copper) per cent	41.74	31.43
Assay of table concentrates (copper) per cent	6.24	9.05
Moisture in general concentrates, per cent	9.79	15.37
Ore required to produce one ton of concentrate, tons	41.74	27.5
Recovery of copper in milling (smelter assays) per cent:		
Calculated from assays only	76.68	78.67
From assays and weights of concentrates and ore	77.78	77.71
From assays and weights of concentrates and tailings	76.94	78.48
From assays and weights of ore and tailings	76.69	.....
Recovery of copper sulphides in ore, per cent	92.81	91.96
Fresh water used per ton of ore—334.5 gal., or in tons	1.395	2.095
Power used per ton of ore milled, kilowatt-hours:		
Coarse crushing	0.46	0.53
Fine grinding and concentrating	9.57	10.44
Blowers for flotation air	2.11	2.34
Filtering and reclaiming water	1.07	0.76
Lighting	0.20	0.12
Total	13.41	14.19
Steel ball consumption in fine grinding, per ton of ore milled, lb	1.5801	1.75
Flotation material used per ton of ore milled:		
Lime, lb	1.38	.....
Sodium xanthate, lb	.05	.....
Pine oil, lb	.12	.....
Coal tar, lb	.....	0.968
Sundry oils, lb	.....	0.108
Total	1.55	1.076

Fundamentals in the Flotation of Sulphidized Oxidized Ores

By FRANK A. BIRD
Metallurgical engineer, Salt Lake City, Utah

IN THE last ten years the flotation of oxidized ores has been frequently discussed. Some of the more important references, excluding patent literature, are given in a box on a succeeding page. Reviewing this literature, I have found that no particular mention is made of the method of preparing the ore for the sulphidizing treatment, except in the paper by Leaver and Lawrence, where the authors state that "the oils were ground with the ore in the pebble mill," but whether by preference or through convenience is not stated. I have reason to believe that the type of grinding media used is of the greatest importance in the preparation of oxidized ore for the flotation process.

My first work was done on samples pulverized on a bucking board or in a laboratory disk grinder; later, a small ball mill was used. By pulverizing in the ball mill, and usually with the sulphide reagent added, commonly found preferable, sulphidization could generally be obtained. It was logical to expect that if sulphidizing of the oxidized ore particles could be obtained by ball milling for a short time with a sulphide reagent, a better sulphidization would result from longer treatment. Trials, however, demonstrated that this was not so, but that the finer the sample was comminuted, thereby exposing more surface for the sulphidizing agent to work on, the poorer were the results.

When an ore is pulverized in an ordinary ball or rod mill, attrition results in a distribution of fine metal particles evenly throughout the mass; at the same time they are subjected to the action of the air and water in the mill, assisted by a slight rise in temperature, which immediately converts them into iron oxides, which precipitate throughout the ore mass, particularly coating the gangue particles with a film of iron oxide. The longer the operation of pulverizing, the greater the amount of oxide precipitated, which readily absorbs the sulphidizing agent, whether added to the ball mill or to the pulp after the milling; and, even if the sulphide be added in additional amount, it continues to be absorbed in preference to a selective sulphidization of the oxidized minerals sought. Flotation of this mass, after such treatment, if possible, results in a large volume of dirty, low-grade concentrate, showing no selective action. The recovery of the desired metals is usually low.

A. F. Taggart, in his "Handbook of Ore Dressing," states that "Forged chrome steel is the most resistant material in common use for balls. Wear with ordinary ores is from 1 to 2 lb. when grinding material from 1.5 to 2 in. to 20 to 48 mesh in closed circuit. The corresponding figures for forged high-carbon steel balls are 1.5 to 3 lb., in closed circuit, and the consumption of cast-iron balls is usually from 1.5 to 2 times that of forged steel, if the balls are 2 in. or smaller. The average wear of manganese-steel liners is 0.5 lb. per ton, when grinding in a closed circuit to flotation size, and of chrome steel, 0.39 lb. per ton in fine grinding. Cast-iron liners are least resistant, the wear in coarse grinding averaging 0.69 lb. per ton."

The natural oxidation of iron to rust produces ferric oxide. If one concedes that the same chemical combination results from ball milling, and ignoring the metal alloyed with the iron or steel, there would be produced from the combined wear of the balls and liners: from chrome steel, 2 to 3.4 lb.; from high-carbon steel, 2.9 to 5 lb.; and from cast iron, 4.7 to 8.5 lb. per ton of ore milled. This freshly precipitated ferric oxide shows great avidity for the sulphidizing agent.

The next step was to try to overcome this disadvantage. By using a pebble mill all the detrimental reactions were avoided, as the formation of iron oxides could not occur; all the sulphidizing agent was effective where desired, except in respect to its influence on the gangue of the ore; a desirable grade of concentrate could be made, and the amount of material returned from cleaning the rougher concentrate was within reason.

The pebble mill produces less slime than does the tube mill, so that its use is preferred. The tailing from a ball mill, owing to the wear of balls and liners, is a red or rust color, and in this respect differs from the tailing of a pebble mill.

In reviewing the literature and patent specifications on the flotation of sulphidized oxidized ores, I can find no mention of the beneficial action resulting from pulverizing in contact only with a siliceous medium. I regard this step as the fundamental essential of oxidized-ore flotation, but there is no evidence that its value has been anticipated or recognized.

In research work I classify the ores into two general groups: those having a high "insoluble" content and a low acid-soluble content, and those having a low "insoluble" content and a high acid-soluble content. In the first class will be found many of the copper ores. The "insoluble" does not readily consume the sulphidizing agent, which allows it to precipitate upon the mineral, thereby insuring high recovery; but even a high "insoluble" content does not signify that obstacles will not be met in flotation. The siliceous matter may be so naturally filmed with metal oxides as to be rendered partly amenable to the process. Most of the oxidized lead ores will be found in the second class, with complete decomposition of gangue and mineral. This class can contain much primary or natural slime, which usually carries too much of the valuable mineral to warrant its being discarded. It absorbs the sulphidizing agent

and floats readily, producing operation complications and lowering recoveries. Exclusive of the primary slime, the acid-soluble portion of the ore usually consists principally of different metal oxides, which are capable of becoming sulphidized or of destroying sulphide.

Each class can contain soluble mineral salts, the most common being the sulphates of iron, aluminum, and magnesium. These, going into solution, are precipitated similarly to the oxidized iron produced during ball milling—that is, entirely through the mass. They sometimes continue to absorb the sulphidizing and flotation reagents, so that even galena cannot be floated. With such ores a washing by thickening after pulverizing removes this interference; but whether or no recovery will be increased by first washing the ore, can be determined only by actual trial. It is usually beneficial, but not generally adopted by research workers.

Sulphidizing and Activating Reagents

When floating oxidized ores, a sulphide film, to aid concentration, is usually desired. It is reasonable to argue that if a normal sulphide will produce certain results, a polysulphide, containing a greater amount of sulphur, should do better; but I have seldom found the polysulphide as effective as the normal sulphide. In floating after sulphidizing with a polysulphide, the action is sluggish and the recovery generally is lower. This suggested the use of an activating chemical in connection with the normal sulphide, the theory being that although the reagent supplied the necessary sulphur, something more was necessary during the flotation period to benefit from the results of the sulphide filming. I find soda ash assists in lead recoveries, and that metal salts are at times beneficial. Caustic soda generally greatly hastens the flotation of copper ores. My theory was that the chemical required would be a precipitant of the metal, but one in which it would not be soluble in an excess.

In floating, a long-continued test usually raises too much gangue and leaves a high tailing. A quick active test makes for improved recovery and insures all of the conditions desired.

Soluble sulphides can be prepared from many substances; ammonium, potassium, sodium, calcium, and barium salts have been proposed, and hydrogen sulphide. Although potassium sulphide should be a more active reagent than sodium sulphide, its cost is prohibitive. Likewise, ammonium sulphide, though efficient, would be an expensive reagent and could be considered only if a cheap supply of gas-house liquor was obtainable. Calcium sulphide rarely gives as good results as does sodium sulphide; it would be applicable only where cost and locality favored its use. The use of barium sulphide could be considered only where barite was procurable.

The Barium Products Company, of San Francisco, quotes fused 60 to 62 per cent sodium sulphide at 3c. per pound. I find the product efficient, and at the price stated it is cheaper than it could be made at the plant. Hydrogen sulphide is efficient as a sulphidizing agent, and its production cost is within reason, but its use is objectionable and its effects are poisonous.

In the A.I.M.E. *Transactions,* 1927, J. M. Callow states that at Magma 1 lb. of hydrogen sulphide required 0.944 lb. of sulphur and 2.36 lb. of oil. It could also be made cheaply from ferrous sulphide and sulphuric acid. Its use would not be as convenient as commercial sodium sulphide; and therefore, unless it materially increased recoveries, it need not be considered.

Normal sodium sulphide contains 58.9 per cent sodium and 41.1 per cent sulphur. Sodium sulph-hydrate, NaSH, contains 41.0 per cent sodium and 57.2 per cent sulphur. In Bulletin 157, U. S. Bureau of Mines, D. A. Lyon and O. C. Ralston, discussing the action of sodium sulphide, the polysulphide and the sulph-hydrate, state:

"Sodium sulph-hydrate seems to be the most active of these three compounds in the sulphidizing of lead carbonate ores. It can be prepared from the normal sulphide by treating the sulphide with hydrogen sulphide gas, the reaction being:

$$Na_2S + H_2S = 2\ NaSH$$

"This would make it more expensive than the normal sulphide when prepared in the pure state. The hydrolysis of the normal sulphide gives sodium hydrate as well as the sulph-hydrate, as follows:

$$Na_2S + H_2O = NaSH + NaOH$$

"The presence of this sodium hydroxide may explain why pure sulph-hydrate of sodium will seemingly be more efficient in its action in sulphidizing a lead carbonate ore, although the explanation is not clear. Results of tests indicate that the advantage of using sulph-hydrate, as compared with the normal sulphide, was not enough to make the separate preparation of the sulph-hydrate worth while."

My theory that the sulphur content of normal sodium sulphide is sufficient is not confirmed by the first part of this statement, and the latter part seems to contradict it. In considering activating chemicals, I have never derived the benefit in using caustic soda with the soluble sulphide that I have when using soda ash in the flotation of lead ores

The statement is also made that "Some of the most successful tests in the sulphidizing of lead carbonate ores followed by flotation of the artificial sulphide were with the normal sodium sulphide of commerce."

Function of Activating Chemicals

In Serial No. 2,811, U. S. Bureau of Mines, discussing the flotation of oxidized copper ores at Ajo, Ariz., the statement is made that "Laboratory experiments with c.p. crystalline sodium sulphide gave indifferent results, but when commercial fused 62 to 64 per cent sodium sulphide was used, the results from the tests immediately improved." It is my impression that the lack of activating chemicals was responsible. Had some caustic soda been used the results would have been entirely different.

If one considers the small amount of reagent employed, its dilution and the volume and varied content of the ore pulp, it is marvelous that any result can be obtained by the sulphide filming of oxidized ores. With an hour's contact of chrysocolla with a 1 per cent solution of sodium sulphide, the mineral becomes greenish black. With a short contact of a strong solution, chrysocolla becomes a deep black and can be made to float.

Flotation Results

The average flotation results of oxidized ores are inferior to those now secured with sulphide ores; the general grade of finished concentrate is lower; and the tailing is higher. Hence the recovery is lower; the reagent cost will always be higher; and the time required to effect results is longer, necessitating more flotation machines.

The beneficial results to be derived on a lead ore from

pebble-mill grinding are illustrated in the following test results, all expressed in percentages:

	Heading	Concentrate		Tailing		
Test	Lead	Weight	Assay, Pb	Weight	Assay, Pb	Recovery
1	7.57	8.74	44.44	91.26	4.04	51.31
2	7.57	6.56	46.45	93.44	4.84	40.25
3	8.30	12.45	56.80	87.55	1.40	85.20

In comparing test No. 2 with No. 1, the very detrimental effect of prolonged grinding in contact with iron or steel is forcibly shown by the greatly lessened recovery. In test No. 3, where the pulverizing was performed in a pebble mill, beneficial results are shown both in the grade of concentrate and increased recovery. In the U. S. Bureau of Mines mimeograph by Ralston and Allen, cited, this ore, Wilbert tailing, is reported as showing 28.2 per cent lead in the concentrate, with a 54 per cent recovery.

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On favorable lead-zinc ores a mixed concentrate for the electrolytic plant can be made. Neither pure calamine nor willemite, the two silicate ores of zinc, show any sulphidizing effect after twelve hours' contact with sodium sulphide solution. The oxidized silver ores I have used have enough lead or copper associated with them so that no trouble has been experienced in securing satisfactory flotation recoveries.

Conclusions

Although a fair recovery can be secured from pulverizing in the ball mill, higher recoveries are invariably obtained by pebble-mill pulverizing. Higher-grade concentrates are also obtained and a much smaller amount of cleaner tailing will be made and returned for re-treatment in the closed circuit. The amount of sulphidizing and promoting agents required is less. By the use of activating chemicals, the flotation time is shortened, necessitating fewer machines. The formation of deleterious iron compounds cannot occur, and the soluble deleterious mineral salts are rejected by washing.

I believe a study of the reactions advanced in this paper will explain many of the negative results with oxidized ores, and greatly assist in solving the problem. Patent application has been made in the sulphidizing flotation of oxidized ores when using a mill having siliceous grinding media.

Germany Imports Hungarian Bauxite

BAUXITE, the essential raw material for the production of aluminum, must be imported into Germany, according to the U. S. Department of Commerce. German bauxite deposits are relatively small, and the ore mined is of poor quality. Imports of bauxite into Germany clearly reflect business conditions in the aluminum industry. In 1927, total imports of bauxite amounted to 540,000 tons, as against 237,000 tons in 1926. Total German production of aluminum for 1926 is estimated at about 30,000 tons, but official statistics are lacking. Hence it may be assumed that total production of aluminum in 1927 will amount to well above 40,000 tons.

A feature of last year's import statistics of bauxite is the change in countries of origin of this material. Hungary, a country which did not export any bauxite to Germany in 1926, has suddenly become the most important source of supply of this product.

Exports of Bauxite Into Germany

	1926	1927
Total imports of bauxite (in metric tons)	236,600	540,000
Imported from:		
Hungary	.....	235,500
France	113,800	153,400
Yugoslavia	27,500	72,900
Italy	89,700	70,200

The above table shows that in 1927 Hungary supplied nearly 50 per cent of Germany's requirements of this raw material. Yugoslavia also gained considerably, whereas French exports increased slightly, and Italian exports decreased.

One reason for this rapid increase of bauxite exports from Hungary to Germany is that the United Aluminum Works (Vereinigte Aluminiumwerke) Lauta (Germany), by far the biggest producer of aluminum in Germany, has acquired a large part of the Hungarian bauxite deposits through a Swiss subsidiary, Bauxit-Trust A. G. Zurich. These mines started production in 1927. Bauxit-Trust A. G. has a stock capital of 11,000,000 Swiss francs, the majority of which is controlled either directly or indirectly by United Aluminum Works.

State Operates Plants at Loss in Western Australia

THE number of ore-treatment plants run by the government in Western Australia in 1926 was 29, according to the report of the State Department of Mines for that year. Gold and tin to the value of £6,033,386 were recovered by these plants; 1,436,980 tons of auriferous ore was treated, this tonnage yielding £4,901,126 by amalgamation, £764,204 by cyanidation, £265,266 by slimes treatment, and £9,353 from residues; 80,728 tons of tin ore yielded tin to the value of £92,864; also, £572 from residues. Gold ore treated was 17,104½ tons, yielding 16,669.29 oz. of bullion.

The working expenditure for all plants for the year totaled £29,648 8s. 8d., and the revenue was £19,269 6s. 7d., indicating a loss of £10,379 2s. 1d. on the year's operations.

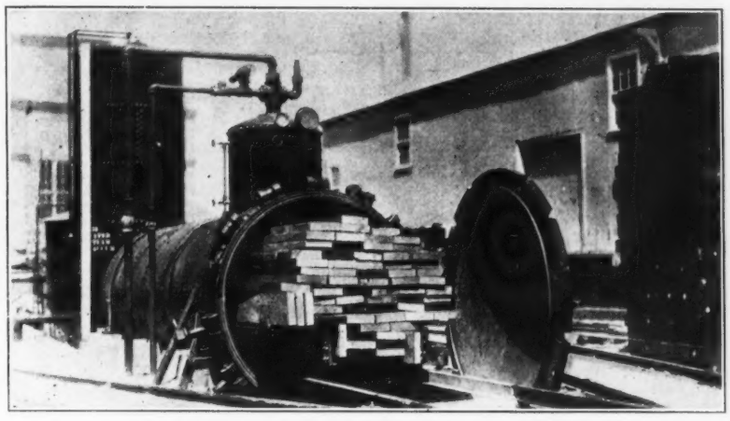
Capital expenditure since the inception of the operations has been £408,443 17s. 8d., including £316,462 16s. from the general loan fund and £91,981 1s. 8d. from consolidated revenue.

Cost of administration for the year was £2,948 10s. 5d., against £3,006 2s. 10d. for 1925. Working expenditure exceeded the revenue by £152,433 2s.

Why Let Mine Timber Decay?—II

Preservative Treatment *and Its* Economy

CONCLUDING INSTALLMENT



Charge of lagging being placed in a pressure-treatment cylinder at the plant of an Arizona copper mine

AS FOUR requirements—food, air, water, and a favorable temperature—are necessary for the growth of fungi, there are four methods of preventing decay of timber: (1) By exclusion of air; (2) by controlling the temperature; (3) by exclusion of moisture; and (4) by poisoning the food supply. Neither of the first two methods has any practical significance; the control of moisture has little practical value except as incidental to standard methods of wood preservation. Certain compounds (such as tars, glues or paraffins) greatly retard the movement of water but do not completely prevent it. This leaves one definite method for preventing decay—the poisoning of the food supply. This is the principle upon which the whole practice of wood preservation is based.

Preservatives

Many preservatives have been advocated since the beginning of wood treatment, but only a few are of importance in America today. The requirements have already been set forth.

Toxicity, as applied to wood preservation, may be defined as the degree to which a substance is toxic or poisonous to wood-destroying fungi.

The U. S. Forest Service, through the Forest Products Laboratory, has made some tests of the toxicity of various compounds toward the fungi, which has been used as an indication, in the hope of finding a consistent arrangement for the toxicity of the elements represented. Bateman and Baechler have described the progress made in this work in a paper presented before the American Wood Preservers' Association.

Many wood preservatives have been used with more or less success for a number of years, and the following data regarding the better known of these are given:

Creosote—This has the advantage of not only being highly toxic but of having the ability to retain its toxicity over a long period. Coal-tar creosote is considered by many authorities to be the most effective preservative for general use. Other requirements and limitations, such as cost, ease of handling, or possible fire hazard, may lead to the choice of another preservative, but not because creosote is considered less effective in preventing decay.

Coal Tar—Although the viscous nature of coal tar, together with its comparatively low toxicity, prevents its use alone, it is frequently used to dilute coal-tar creosote in the proportion of about 80 per cent creosote to 20 per cent tar. This mixture is lower in price than straight creosote, and it is claimed that it is sufficiently toxic for wood preservation.

Water-gas Tar Creosote—Water-gas creosote is a by-product from the manufacture of water gas in which petroleum oil or gas oil is used. It is not as toxic as coal-tar creosote, but is cheaper.

Wood-tar Creosote—Wood-tar creosote, a distillate of wood tar, is not used to any extent in America. Its efficacy has not been demonstrated clearly, although it is known to retard decay.

Low-temperature Tar and Creosote—In the event that the destructive distillation of coal at low temperatures becomes an industry of major importance, a large amount of low-temperature creosote would be available for wood preservation. Little is known about its efficacy as a wood preservative.

Crude or Semi-refined Petroleum—Petroleum is not a good preservative to use alone, as proved by one of the railroad companies. A new process is being tried whereby an emulsion of zinc chloride and petroleum oil is used, the zinc chloride as the toxic agent and the petroleum as a protection against moisture and weathering.

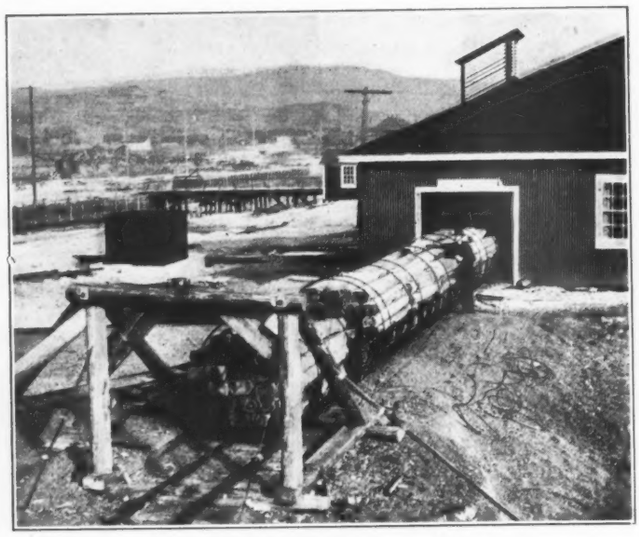
Zinc Chloride—Zinc chloride ranks next to creosote in point of quantity of wood treated with it per year. Its low cost, together with good results obtained, makes it one of the most popular preservatives, particularly for railroad use.

Zinc chloride is soluble in water in all proportions, a property that prohibits its use in regions of extremely heavy rainfall or in places subject to the action of run-

The first article of this series, which presents in abstract form a monograph by L. D. Tracy and N. A. Tolch published under the auspices of the Carnegie Institute of Technology, the U. S. Bureau of Mines and certain advisory boards, appeared in *Engineering and Mining Journal* of April 14, 1928.

ning water. It is shipped either as a 50 per cent solution or as a dry-fused salt. As it is deliquescent, the latter must be sealed in air-tight containers. For long freight hauls it is advantageous to buy the dry salt to save freight charges. One-half pound of zinc chloride per cubic foot of timber is generally used.

Sodium Fluoride—Because of its cost, sodium fluoride has not been used extensively in America as a wood preservative, although it is probably more toxic than zinc chloride. Service tests indicate that it is an excellent preservative. In Germany, it is widely used.



Treated ties being removed from the treatment cylinder at a copper mine in Butte

Sodium fluoride is soluble in water up to about 4 per cent. From ¼ to ½ lb. per cubic foot of material treated is the usual recommended absorption. The salt is not deliquescent and does not require air-tight containers.

Mercuric Chloride—Mercuric chloride, or corrosive sublimate, was one of the first preservatives to be used in America. It is undoubtedly an effective preservative, but its extremely poisonous nature and corrosiveness to metals limit its use.

Copper Sulphate—Copper sulphate has had no commercial application in America as a wood preserver. Its preserving effect has been frequently noticed in the copper mines where mine waters have impregnated timbers. In Europe, it has been used with the Boucherie process for impregnating green poles.

Arsenic—Arsenic, a byproduct of the copper smelters in the West, is being tried as a wood preservative. It has been used successfully in the form of powdered arsenic trioxide for the butt treatment of poles, and recently a method for using the salt in the form of a solution of sodium arsenite has been invented. Although the results of the experiments are encouraging, more complete information is needed.

Proprietary Preservatives—A number of high-boiling coal-tar distillates, fractionated especially for open-tank and brush treatments, are sold under various trade names. These oils are somewhat higher in price than straight Grade 1 coal-tar creosote.

Ac-Zol is a preservative which originated in Belgium about seventeen years ago. Its use in America has not been extensive. It is shipped in a concentrated solution to be diluted with 94 parts of water when used. Ac-Zol consists of copper, zinc, and phenol held in solution by ammonia.

Wolman salts originated in Germany about twenty years ago. This preservative is now used fairly extensively in that country, particularly for mine timber. It consists mainly of sodium fluoride, to which have been added other compounds to increase the toxicity and effectiveness.

Basilit is a foreign preservative composed of 88 per cent sodium fluoride and 12 per cent dinitrophenolaniline.

Processes for Preservative Treatment

Following is an outline of the various processes employed in treating timber:

Non-pressure	Painting or spraying Dipping Soaking or steeping Hot and cold bath
Full cell (Card, Bethell, Burnett, and others)	Initial vacuum Pressure Final vacuum
Empty cell (Lowry)	No initial vacuum or air pressure Pressure Final vacuum
Empty cell (Rueping)	Initial air pressure Pressure Final vacuum

Some details of these processes follow:

Non-Pressure Processes

Painting or Spraying—Painting is the simplest of all preservative treatments. Creosote is commonly used and should be applied hot. A pail and brush is all the equipment needed, although an air spray may be used. This method cannot be recommended for permanent treatment, but it is suitable for brushing surfaces of untreated wood which have been exposed by the cutting of treated wood. More than one coat of preservative should be applied.

Dipping—Dipping consists of submerging the timber in a hot preservative for 10 to 30 minutes. A tank or vat is needed to treat several timbers at one time. The preservative may be either an oil or a salt solution, such as zinc chloride, and should be hot, but must be kept below the boiling point.

Soaking—In soaking, timbers are submerged in a cold solution for a long period. A salt solution such as zinc chloride, sodium fluoride, or mercuric chloride may be used. Treatment with mercuric chloride is called Kyanizing, after its inventor John Kyan. Metal tanks cannot be used, on account of the corrosive action of mercuric chloride on metal. The treatment period may vary from a day to several days, depending upon the condition and kind of timber and the absorption desired.

Hot and Cold Bath—The timber is submerged in a hot bath of preservative for a certain period, which is followed immediately by a cold bath. During the hot bath, air in the wood cells is expanded; during the cold bath, it is contracted, creating a partial vacuum which draws preservative into the wood cells. In general, any preservative may be used. The period of treatment is usually from four to six hours, although it may be longer.

Pressure Processes

Pressure processes are either full cell or empty cell. In the former the cells of the wood are completely filled with preservative to the depth of penetration; whereas

in the empty-cell process a portion of the preservative is withdrawn, leaving just a coating on the cell walls. Treatment in both processes is accomplished by placing the charge of timber in a cylinder in which preservative is forced into the wood by pressure. In the full-cell processes three steps—initial vacuum, pressure period, and final vacuum—are essential.

1. The charge is subjected to a vacuum of 20 to 24 in. of mercury for a period of 10 to 30 minutes to reduce the air content of the wood cells.

2. Without breaking the vacuum, preservative is admitted to the cylinder and pressure is put on the cylinder. The temperature of the preservative should be 180 to 200 deg. F. Pressure is usually maintained at 125 to 175 lb. per square inch until the desired absorption is obtained or until the wood is treated to refusal, which may take from two to six hours.

3. A final vacuum is drawn for about half an hour to dry the charge and prevent excessive bleeding of preservative.

In general, any preservative can be used with the full-cell process with certain modifications in the method. If creosote is used, the process is called the Bethell process; with zinc chloride it is called the Burnett process, and with a combination of creosote and zinc chloride it is called the Card process.

Empty-Cell Processes—There are two empty-cell processes in which creosote is used almost exclusively—namely, the Rueping and the Lowry. The former process may be divided into three steps—initial air pressure, pressure period, and final vacuum; and the Lowry process is similar except that the initial air pressure is omitted.

1. *Rueping Process*—An initial air pressure of 45 to 110 lb. per square inch is put on the charge and the air in the wood cells is thereby compressed.

2. Without breaking the air pressure, preservative is admitted to the cylinder at a higher pressure. The temperature of the preservative is held around 170 to 200 deg. F. and a pressure of 150 to 200 lb. per square inch is maintained.

3. On the release of pressure, the air in the wood-cells expands, causing a "kick-back," or withdrawal, of part of the preservative. A final vacuum is drawn to dry the charge.

Comparison of Treatment Processes

It is doubtful whether there is any industry which uses treated timber in a way that is more destructive to its preservative treatment than mining. The tendency of the timbermen in the mines is to cut the timbers to fit the roof; the custom of sticking picks, axes, and hatchets in the posts; the bruising of timbers near the face by flying rocks from blasting; and the small clearance between mine cars and the posts are all injurious to treated timber, unless the toxic seal is so deep that these mutilations do not break through. Hence, a penetration as deep as possible is desirable in most treated mine timbers. The penetration of a preservative is a highly variable quantity. It will vary in any one piece of material through lack of uniformity in the wood; also because there is a difference in the rate of absorption between the end and side, or radial penetration. For most woods, almost complete penetration can be expected near the ends by pressure treatment.

In the next column are listed advantages and disadvantages of the different methods of timber treatment, with especial reference to the use of the timber in mines:

Advantages and Disadvantages of Treatment Methods

Advantages	Disadvantages
Painting	
Cheap. Useful in protecting faces when treated timber has been mutilated. Will prolong life of timber in fairly cool and ventilated places.	Gives no penetration and timber so treated can stand no rough usage, as it breaks the toxic seal. Of doubtful efficiency in warm and moist atmosphere.
Dipping	
Cheap first cost for equipment. Simplicity of operation. Better than no treatment.	Cost of labor nearly as much as in other methods, but with little penetration. Would not prolong life of timber where liable to mechanical wear.
Soaking	
Cheap first cost for equipment. Simplicity of operation. No application of heat necessary. Will give fairly satisfactory results and will prolong life of timber even in hot and moist atmospheres.	Cost of labor nearly as much as in other methods which give better penetration. Would not prolong life of timber where liable to mechanical wear. Takes several days' treatment to obtain the best results.
Hot- and cold-bath	
Cheap first cost for equipment, although more expensive than dipping or soaking tanks. Under certain conditions will give good penetration with certain species of wood. Timber properly treated should have life prolonged two or three times. More efficient than dipping or soaking.	Costs as much as other methods. Requires considerable time to obtain deep penetration; hence larger capacity plant needed to do same work as pressure plant. More difficult to control amount of preservative retained by timber. More skilled labor required than in preceding methods; hence higher labor costs.
Full-cell	
Gives the greatest penetration, and timber treated with this process can better stand mechanical wear. Will prolong life of timber an indefinite period if properly treated and no injury done to timber. Labor cost per unit of timber treated not much greater than in cheaper processes. Shorter period for same penetration as hot and cold baths. Most effective for extremely hard service.	First cost of equipment greater. Closer supervision required. More machinery, such as pumps and air-compressors, needed. Steam is necessary. Greater amount of preservative used in comparison with preceding methods; although small amount of preservative in itself is not always an advantage.
Empty-cell	
All advantages of full-cell with less preservative used. Doubtful if timber will stand wear as well as full cell and whether it will last as long. Should resist decay in all mine timbers, except shaft timbers, as long as life of mine. Gives maximum service with minimum amount of preservative.	Same as full cell.

A "Style" in Safety—The Hard-Boiled Hat

NO ONE—miner, manager, or visitor—is allowed to go underground at the Moctezuma Copper Company's mine at Pilares, Sonora, Mexico, unless he is wearing the so-called "hard-boiled" hat, according to a recent circular issued by the U. S. Bureau of Mines. The company furnishes these hats to the men for 50c. each and replaces damaged ones free of cost. This order has been in effect for over a year, and, should it be rescinded, nearly all of the men would undoubtedly continue to wear such hats anyway. There is no question that compulsory use of the "hard-boiled" hat has had a decided influence toward reducing accidents from falls of rock.

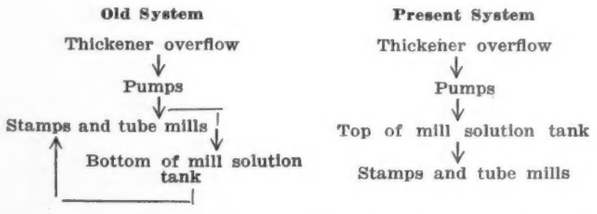
On April 8, 1927, a piece of ore weighing 87 lb. fell through the top lagging in a square-set stope for a distance of 4 ft. and struck a miner on the top of his head. The hat was crushed, but the man's head was uninjured. Two weeks later he was still in the hospital with a sprained and stiff neck, but he was expected soon to be released. Seven other crushed hats are exhibited in a case near the collar of the shaft; each hat saved its wearer from a serious accident and in at least one instance preserved his life.

The Mills-Crowe Cyanide Recovery Process in Honduras

By PAUL T. BRUHL
Mill Superintendent, New York & Honduras Rosario Mining Company, San Juancito, Honduras

THE Mills-Crowe cyanide recovery process plant at the mill of the Rosario Mining Company was started in June, 1926, and effected during the first year of operation a gross saving in cyanide valued at $21,000. Lack of experience in direction and an inadequate supply of native labor undoubtedly adversely affected the results. At first the native operators showed a marked disinclination to work in the plant, owing to a fear that the atmosphere would be poisonous. During the first few weeks some complained of illness, which proved to be founded on nothing more serious than a vivid imagination. The beginning of operation was handicapped by changes in personnel, and constant trouble, principally due to the burning of insufficient sulphur, which caused a heavy deposition of calcium sulphite on the grids of the dispersing towers. As the operators became convinced that no danger threatened, trouble from this source disappeared. The plant has run for several months without changing the disperser grids and no trouble is expected in the future.

The flow sheet at first was arranged so that the mill solution tank "floated" at the end of the Dorr thickener overflow pump line. As mill solution is used for absorbing the hydrocyanic acid gas, it frequently happened that the absorbing solution contained little or no lime; lime, therefore, was added as it left the absorbers on its way back to the mill solution tank. After several months, undissolved lime and the impurities in it accumulated in the mill solution tank, causing trouble in the absorbing towers. A new line was therefore put in, and all the thickener overflow was pumped into the top of the mill solution tank. This change makes it unnecessary to add lime in the cyanide recovery plant, all the required lime being added in the mill.



The iron tops on the acidifier have been replaced by wooden covers. Iron plates were tried in the tower to provide the curtains of solution, but proved a failure, owing to rapid corrosion. It is advisable, if practicable, to make all connections on the acidifier of wood. The discharge from the suction blower is passed to the atmosphere. If passed to the absorbing towers, calcium sulphite forms on the lower grids, thereby rapidly lowering the efficiency of dispersion. The sprays have been a source of trouble. Even the head solution, which has, of course, passed through the precipitation press filters, does not provide an entirely reliable spray. A pipe is used, perforated with many small holes and extending across the tower. It appears to be better for general results than the sprays provided with the equipment. The sprays on the absorbers have been dispensed with as an unnecessary refinement. The towers, of concrete, are beginning to disintegrate after eighteen months' use.

In the second year of operation the results of the first year are being improved upon. An efficiency of 96 per cent in transference is satisfactory, especially when one considers that the total daily labor cost is now $3. The working of the plant, so far as the operators are concerned, is regulated entirely by eye. Sufficient sulphur is burnt to produce minute prickles on the surface of the solution in the acidifier sump and to cause the plant effluent solution to assume a slightly milky color. The additions to the burner are made every half hour.

With this solution it is usually inadvisable to pass more than 700 tons per 24 hours through the plant. Efficiency of transference depends on the rate of passage through the dispersing towers and on the concentration of hydrocyanic acid present in the solution under treatment, this latter appearing to be, to some extent at least, independent of the tonnage. That is to say, if the head solution runs more than 2.75 lb. total potassium cyanide per ton, the efficiency of transference nearly always falls, even if the tonnage of solution being decyanided is reduced.

When the plant was first started the effluent solution was used as a barren wash, the idea being to conserve water—important during the dry season, for electricity is generated by water power. This procedure proved to be incorrect; the solutions were fouled by sulphur compounds, and trouble was experienced in the precipitation and refinery departments. The effluent solution was then diverted into a tunnel and used, during water shortage, to sluice the slime presses. That this is wise may be doubted, as sluicing water should not contain solids. It is a question of choosing the lesser evil. To sluice a press with the Mills-Crowe effluent solution may be an advantage, because of acidity and consequent cleansing action on the filter cloth.

As the slime press cycle is limited by the tonnage milled, at times the efficiency of transference has not been satisfactory, and a third dispersing unit might be a valuable addition. In other words, the head solution of the plant has contained too much cyanide to be properly dispersed in two units. It might pay to pump the effluent from No. 2 disperser to a Crowe vacuum-process tank, as is used prior to precipitation, and to lead the gaseous discharge from the vacuum pump into the bottom of No. 2 absorber.

Some silver ores need a strong cyanide solution to insure satisfactory extraction. The saving effected by the Mills-Crowe process enables one to increase the cyanide strength at less cost than in former years. It must be remembered, however, that the question must be regarded solely as an economic one. Increasing the cyanide strength of the solutions causes additional expense because of increased physical losses, increased chemical losses (the more important) and a higher sulphur consumption. It is believed that, wherever possible, a longer agitation period and finer grinding will in the long run yield larger profits than an increase in the strength of the cyanide solution. After a certain extraction has been achieved, further improvement is obtained only by additions of cyanide out of all proportion to the final economic results.

A typical slime press cycle is as follows:

Charge	12 minutes	Rich circuit.
Water wash	10 minutes 40 minutes	Poor circuit (for decyanidation after precipitation).
Air-blow	6 minutes	
Discharge	16 minutes	

Results covering the last ten-day period are as follows: Plant heads—1.82 lb. total KCN; 0.36 lb. CaO per ton; No. 1 disperser discharge—0.64 lb. total KCN per ton; No. 2 disperser discharge—0.07 lb. total KCN per ton; alkalinity of plant effluent equivalent to 1.24 lb. CaO per ton.

The disperser fans are run at 1,050 r.p.m. The grid staves in the dispersers are spaced at $\frac{7}{8}$ in., and in the absorbers at $1\frac{1}{2}$ in.

The Mills-Crowe process may be used to advantage on good-grade silver properties and on out-of-the-way properties where the cost and transportation of cyanide are important considerations. That it can be used profitably in mills treating lean gold ores is open to question. Over and above the saving derived from a decreased cyanide consumption, the process offers other advantages: The solutions throughout the mill are cleaner; the relatively cheaper Aëro brand cyanide can be used exclusively; precipitation is better; the refinery charges are lower; and the recovery, in this instance is about 0.4 per cent higher. When using zinc dust for precipitation, the consumption of zinc may be a little higher, owing to an effort to have no silver in the refinery solution from the poor circuit, which goes to the Mills-Crowe plant. Precautions in this respect may prove ultimately to have been unduly great.

Production of Magnesite in 1927

PRODUCTION of crude magnesite in the United States in 1927 was 121,490 short tons, valued at $1,090,550, according to statistics compiled by the U. S. Bureau of Mines. Three operators working three mines, one each in Santa Clara, Stanislaus, and Tulare counties, Calif., produced and sold 43,750 tons of crude magnesite, valued at $507,500. All the output in Washington was from the mines of the Northwest Magnesite Company, which produced dead-burned magnesite at Chelwelah. Two of its six furnaces were operated only part of the year.

Magnesite Supply in the United States, 1922-27
Expressed in Crude Magnesite, in Short Tons

Year	Domestic	Imported	Total (a)
1922	55,790	217,861	273,651
1923	147,250	151,092	298,342
1924	120,100	148,700	268,800
1925	120,660	142,283	262,943
1926	133,500	196,318	329,818
1927	121,490	149,126	270,616

(a) Prior to 1924 a factor of 2 tons of crude to 1 ton of calcined was used in expressing imports as crude magnesite. Since 1924 the factors used are 2 to 1 for imports from Italy and 2½ to 1 for other imports.

Imports of magnesite in 1927, according to the Bureau of Foreign and Domestic Commerce, aggregated 891 short tons of crude, valued at $9,790, of which 88 per cent came from Greece; 9,463 tons of caustic calcined, valued at $229,592, of which 60 per cent came from India and 33 per cent from the Netherlands; and 49,873 tons of dead-burned, valued at $727,881, of which 75 per cent was from Austria and Czechoslovakia. Corresponding figures for 1926 are 608 tons of crude, valued at $6,555; 14,830 tons of caustic calcined, valued at $330,131; and 77,108 tons of dead-burned, valued at $1,128,823.

Prices of Magnesite

Domestic producers reported sales of crude at from $7.50 to $13 per ton, f.o.b. shipping point of mine, and the average price for all magnesite sold crude was $9.52 per ton. Producers of caustic calcined in the United States reported sales at from $30 to $34 per ton, the average price for the total sales of domestic being $32.60 per ton. Domestic dead-burned was sold at from $24 to $29 per ton, the average price for the entire output being $24.63 per ton, f.o.b. shipping point.

Domestic Supply of Magnesite in Various Forms in 1927

	Sales (domestic)		Imports		Total	
	Short Tons	Value f.o.b. Mine	Short Tons	Declared Value	Short Tons	Value
Crude	1,800	$17,130	891	$9,790	2,691	$26,920
Caustic	13,890	452,810	9,463	229,592	23,353	682,402
Dead-burned	40,210	990,300	49,873	727,881	90,083	1,718,181

Producers reported stocks of 6,150 tons of crude magnesite at plants on Dec. 31, 1927. By proclamation, under the Tariff Act of 1922, the President on Nov. 10, 1927, increased the import duty on magnesite as follows: Crude magnesite, from $\frac{5}{16}$ to $\frac{1}{3\frac{1}{2}}$c. per pound (from $6.25 to $9.375 per short ton); caustic calcined magnesite from $\frac{5}{8}$ to $\frac{1}{1\frac{5}{6}}$c. per pound ($12.50 to $18.75 per short ton).

South African Labor Conditions

DENUNCIATION of the Mozambique convention has created a labor problem for the Johannesburg gold mines; unless an agreement is reached before June 1, 1928, the recruiting of natives in Mozambique will stop, according to the U. S. Department of Commerce. For several months past the gold mines have been operated with an estimated shortage of 6,000 natives, although the total number employed on the Johannesburg mines has been nearly 188,000—the largest for several years. Mozambique supplies 40 per cent of the natives in the mines. The Transvaal Chamber of Mines is trying to discover other sources of supply and to effect every possible economy in the utilization of labor. Production of the mines, however, is continuing at a high level, and came to 9,278,367 oz. gold during the first eleven months of 1927, almost equal to the annual production of the two preceding years, which amounted to 9,597,592 oz. for 1925 and 9,954,762 for 1926. The half-yearly dividends have also been well maintained, on the whole, although one or two of the companies felt that it was advisable to reduce the rates in anticipation of labor difficulties.

COMMENT AND CRITICISM

Diamond Digging in South Africa

THE EDITOR:

Sir—Although diamond digging calls for little special qualification beyond patience, it may be recommended to the man with small capital who has not been successful in other walks of life. At all events, for about two hundred miles along the banks of the Vaal River, in South Africa, diamonds are to be found, and at the cost of little machinery and labor. True, diamonds are not picked up every day; they vary in value; the shape, size and color of the stone often prove most disappointing.

It is usual for the digger to take a partner, who, like the other member of the firm, should be a person of good character. In fact, the local magistrate will entertain an application for a license only from those who can present a clean-conduct sheet. And, to make certain that no undesirables are admitted to the camp, the applicant, after furnishing satisfactory replies to many searching questions, must submit to having his name posted while the diamond detective staff is busy inquiring into his antecedents and history. If his past has been a blameless one, so much the better for him; should it be otherwise, he will not be allowed to dig for South African diamonds. If an adverse report is made to the magistrate, the disappointed fortune hunter is ordered to leave, and the miners see that he does so, expediting his departure if the interests of public morality demand drastic action. As a rule, the unwanted one clears out before the police have had time to find out more about him. "When in doubt, bunk" has ever been the diamond diggers' working motto.

Should the applicant stand investigation satisfactorily, the next step is to obtain a claim license—an easy matter. The magistrate having guaranteed the applicant, the rest is merely a matter of form; there being "no cause or just impediment," the business, like the marriage service, proceeds smoothly. Diamonds or disappointments now lie before the prospective digger.

The diamonds are hidden in the gravel from a few inches below the surface to 20 ft. or so below it, and the claim averages 80x20 ft. As to labor, that is a simple matter, for the Kaffir "boys," who are experts at finding—and, if not watched, at keeping—the stones, are ready to work the greater part of the day for 10s. a week and board. If properly treated, they serve the "Baas" well, always working cheerfully, glorying in his success, and sympathizing with him when bad luck comes along. Treat them badly, and they will decamp at a critical moment, taking with them the fruits of their employer's industry. If caught, however, the punishment is a heavy one: when brought to book for illicitly disposing of the diamonds, a dungeon cell will house them till they die. On the principle that "the receiver is worse than the thief," the person who relieves the Kaffir of the booty is treated in like manner—provided the scales of justice are held evenly. Many are the stories told of white men who, with the assistance of absconding black men and getting the better of the law, have suddenly sprung from obscurity into opulence. Perhaps, and perhaps not; the Vaal is a censorious neighborhood.

A tent, cooking utensils, provender, a rotary machine, picks and shovels—these have to be bought and labor must be engaged. Then the partners are ready to tempt fortune, which, alas, often takes considerable tempting. The disgruntled twain, after months of isolation, boredom, and savagery, may be glad to sell the plant and the unproductive claim for a trifle, and, shaking the yellow dust of South Africa off their feet, try their luck elsewhere. Others, more fortunate, light upon diamonds and quickly amass money. But, at the best, diamond digging is a precarious undertaking—and one that tries human endurance to its utmost limits. He who grows rich at it deserves his good fortune.

Every now and then a valuable stone is found—perfect in every respect and perhaps of unusual size; it may realize a small fortune and enable the partners to dispose of the claim at a substantial profit and return to their native land. Other exiles languish for years without making more than a living.

The first thing to be done on a new claim is to rid the surface of the boulders that encumber it. The gravel is then pushed to one end of the claim and transferred to the rotary machine, much water being added. By an ingenious arrangement, the contents are kept continuously on the move till the gravel is cleaned. Finally, it is put through a sieve and so manipulated that the heavier matter falls to the bottom. When the sieve is turned over, the diamonds, if any, will have gravitated to the center of the heap. Nothing, however, is left to chance. The residue is diligently sorted, scraped, and rescraped, till every fraction of an inch has been explored. This is often heart-breaking work, and days may pass without the smallest stone being found. At such times the digger loathes the sight of South Africa and the Vaal River.

If, on the other hand, the sieve yields anything, the result must be reported to the authorities, who enter particulars of the find in a register. They are also notified of the sale of any diamonds found, the buyer's name and address, and the price realized. The buyers visit the mining camp periodically, bringing with them news of the outside world, illustrated papers, whiskey, and other evidences of civilization. They are as welcome as flowers in spring, and fair prices invariably are given.

GEORGE CECIL.

Paris, France.

* * *

The Parish of the Mining Engineer

Sir—The conclusion of your editorial on unemployment of March 31 makes me laugh. The allied industries — in fact, all industries—present an equally troublesome situation of unemployment of professional men. That versatility which is so important a qualification of the mining engineer is a most important disqualification in the other industries. The skill and experience demanded are those kinds of mental and manual dexterity in the routine performance of special duties which result from long experience in narrow specialties. Every salaried position, and every opportunity for investigations, designing, or consultation, evokes a swarm of candidates who have had this special experience. Against such competition the mining man is helpless because his experience and reputation mean nothing to an employer who does not know what is done at a mine or smelter. The change means beginning at the very bottom and working all the way up again, unless one has those special opportunities obtainable only by investment of capital, or by family pull. Men in other businesses still think that mining engineering is a profession of high pay and great opportunities, and their minds jump at once to the suspicion that the man who wants to quit it must be no good. Therefore it is exceedingly difficult for him to get any job at all, even at the very bottom.

Gorham, Me. R. E. SAWYER.

[We venture to disagree with our correspondent, from personal knowledge of the successful migration of many mining engineers into other fields of endeavor. As we have before maintained in these columns:

"Experience that can be turned to account does not necessarily mean the acquisition of facts and figures; but, rather, an ability to eliminate the non-essential. It does not mean proficiency in one circumscribed art or industry, although it may include this, and more. If experience does not teach us to do all things well, we have failed to learn its lesson. The Great War brought this fact home to many individuals whose motto insists that the shoemaker should stick to his last.

"It was not the knowledge of mining engineering that enabled Herbert Hoover to help, swiftly and efficiently, the thousands of stranded Americans in Europe in 1914, thereby relieving our embassy in London in a situation that had taxed the ingenuity of the government's representatives. He did not make a success of the task because he was proficient in handling refugees. He just happened to be a man of experience—and a mining engineer.

"It was not proficiency in architecture or building construction that enabled Colonel Peter N. Nissen to evolve a simple and serviceable hut for the use of the troops on the Western front, thereby solving a problem that probably would have baffled a committee of the most proficient house designers and building constructors in the world. No, he did not make a success of hut design because he was proficient in that art. He just happened to be a man of experience—and a metallurgist—whose ingenuity had found outlet at one stage in his professional career in the invention of the high-duty stamp mill that bears his name. . . .

"Similarly, in other branches of endeavor, the mining engineer has great opportunities, which if exploited fully should bring kudos to himself and credit to the profession. Too often, however, he stays in the same groove, unaware of his own manifold abilities. If correspondence schools had a course in self-confidence—aggressiveness, even—many capable mining engineers could learn much to their material advantage, thereby profiting by that experience which, in early life at least, is the most costly form of education."—EDITOR.]

* * *

The Institution's Gold Medal to Mr. Pearce

THE EDITOR:

Sir—In the *Engineering and Mining Journal* for March 10, Mr. T. A. Rickard, in referring to Mr. Richard Pearce, states that the gold medal of the Institution of Mining and Metallurgy was awarded to Mr. Pearce "'in recognition of the services which he had for so long rendered to the advancement of metallurgical science and practice' as the president, Sir Thomas Holland, stated on the occasion of the award." Please note that it was I, and not Sir Thomas Holland, who had the honor of handing the gold medal to Mr. Richard Pearce on the occasion mentioned.

HUMPHREY M. MORGANS.

London, England.

An Appeal to Readers

THE EDITOR:

Sir—I have just had a fire at my residence, in which my office is also located. The fire has destroyed fifteen consecutive years of *Engineering and Mining Journal,* which were unbound but kept in order. I am anxious to get in touch with someone who keeps old files of *Engineering and Mining Journal* in order to get a figure on replacing these. STEPHEN ROYCE.

Crystal Falls, Mich.

[Any reader who has a set he is willing to part with should communicate direct with Mr. Royce.—EDITOR.]

* * *

The Market for Vanadiferous Material

THE EDITOR:

Sir—In the issue of *Engineering and Mining Journal,* March 17, 1928, page 460, there is published an inquiry for the sale of vanadio-ores under the title of "No Open Market For Vanadium Ore." I would ask it as a favor if you would notify the inquirer that this writer, especially, is in the market for all grades of rebellious and complex vanadio-ores, and concentrates. Preferably lead vanadate would answer my requirements, although I am prepared to accept other ores of definite rebellious and complex characteristics, provided, however, the uranyl content is practically nil. High-grade crude ore, or concentrates dressed from the following types of vanadio-minerals, such as sulvanite, fernandinite, pascoite, minasragrite, patronite, and asphaltite — South American mineral products—and roscoelite, brackebuschite, pucherite, hewettite, descloizite, cuprodescloizite, volborthite, calciovolborthite, vanadinite, mottramite, pintadoite, and meta-hewettite; also slags from copper and iron smelters, where the contents of vanadic acid has a minimum of 0.85 per cent V_2O_5 are acceptable to our firm. Price per pound vanadic acid contained per ton is determined by analysis. The higher the contents of vanadic acid in the concentrates, the more is paid for the material per pound contained.

Roughly, our concentrate specifications are as follows:

	Per Cent
Vanadic acid, V_2O_5	10 to 18
Copper, maximum	5 to 10
Zinc, maximum	10 to 15
Aluminum, maximum	2 to 8
Antimony, maximum	1 to 7
Bismuth, maximum	2 to 8
Wulfenite as $PbMoO_4$	10 to 15
Arsenic	5 to 11
Phosphorus	2 to 4
Uranium	None

At present I am trying to secure sufficient supplies of these complex and rebellious vanadio-minerals for the installation of a chemical plant on the Atlantic seaboard—New Jersey—for the production of sodium vanadate slag for shipment to European plants, where it is reduced to its salts as ammonium meta-vanadate and other chemical by-products. Our credentials will qualify us to purchase this mineral product, either in the crude ores or the dressed material as a concentrate that will meet the above specifications.

No other chemical plant in this country is treating ores containing 0.30 to 0.85 per cent contained vanadic acid, because they cannot dress these low-grade ores in a concentrate containing 10 per cent pentavalent oxide.

KARL S. REINHART.

Los Angeles, Calif.

* * *

Are the Days of Salted Mines Entirely Past?

THE EDITOR:

Sir—A gold prospect was brought to my attention, and two independent samplings by engineers of the main workings, showing some 200 ft. of vein exposure, were given me. Each showed an average of about 3½ oz. gold and an average width of slightly less than 2 ft. My own sampling, based on a greater number of samples, roughly checked this.

I had secured an option on the property from the owner that called for a cash payment of 25 per cent of the purchase price before any work, other than sampling, could be done in the mine—a condition that tends to give one a feeling of gloom, no matter how plausibly explained. And the gloomy feeling was not brightened by the samples taken in several shallow pits on the outcrop of the vein that ran only a dollar or two, though these pits were some distance from the shaft and might have been outside of an oreshoot.

The mine was some distance away, so to satisfy a lurking suspicion that wouldn't stay down, though it had been dismissed several times, some of a sample pulp, which assayed about 7 oz. gold, was panned and the concentrate, in which no gold could be seen, was assayed, and it only went 2.6 oz. This, of course, appeared puzzling and excited interest, so a half assay ton of the pulp was taken and agitated and soaked in cold water and then assayed, giving 2.4 oz.

I was being forced to the conclusion that there was something about gold ore in veins that I wasn't acquainted with—likely enough; or that the mine had been salted. I considered salting of my samples out of the question.

To pursue the matter farther, an assay ton of the pulp was thoroughly mixed on a rolling sheet. Half of this was assayed, and ran about 7 oz., thus checking the original assay of the pulp. The other half after boiling in distilled water assayed 0.9 oz., and the water filtered off gave a strong reaction for chloride when tested with silver nitrate.

Again a portion of the same pulp was boiled in dilute nitric acid and assayed, giving about 0.6 oz. Another portion was boiled in water and dropped to 4½ oz. A pulp from a sample assaying 1 oz. assayed ½ oz. after boiling in water. A pulp from a sample of ore on the dump that had been exposed to the weather for years assayed about 0.3 oz., and after boiling in water it assayed the same.

The little mine is an old one and in a district that has produced high-grade gold ore and also placer gold. Some

years ago the district went through the throes of a high-pressure promotion campaign.

The idea of a water-soluble gold salt occurring naturally in an oxidized pyrite vein, not appearing tenable, rather forces the conclusion that the mine is salted. I have heard frequently of salted samples and vaguely of salted mines, but this is my first contact with a mine that appeared to have been salted. I was of the opinion that the days of mine salting were past. And, indeed, this one may have been salted years ago, if salted it is.

The results of the various boilings are not very consistent from a quantitative viewpoint, but from an economic slant I found them convincing.

Though not confirming the evidence of salting, perhaps, I should add that I sent away some of the 7-oz. pulp for examination. It was reported that after concentrating and boiling the concentrate in hydrochloric acid, washing and drying, abundant spongy gold could be seen with a microscope. I think, however, that this does not necessarily conflict with the results obtained in the boiling tests.

MARC BAILEY.

Bisbee, Ariz.

Consultation

Where Copper Goes

"We are desirous of compiling a list of manufacturing companies that consume large quantities of refined copper. As a preliminary can you supply us with a list of the industries that use copper as one of their important raw materials?"

The following compilation and the accompanying explanatory notes are taken from the most recent issue of the Year Book of the American Bureau of Metal Statistics. They represent the year 1926.

Estimated Consumption of Copper in the United States

Industry	Tons
Electrical manufactures (*a*)	201,000
Telephones and telegraphs	90,000
Light and power lines (*b*)	117,000
Trolley wire	7,000
Wire and rods (*f*)	74,000
Wire cloth	7,000
Steam railways electrified	400
Automobiles (*c*)	102,800
Automobile brake lining	1,700
Buildings (*d*)	50,200
Locomotives	2,900
Railway cars	6,150
Air brakes	2,000
Ships, commercial (*d*)	2,100
Ships, naval (*d*)	400
Bearings and bushings	38,000
Valves and pipe fittings	26,000
Ammunition	5,700
Lubricators	5,000
Condensers	2,000
Fire-fighting apparatus	2,700
Agricultural machinery	1,100
Cash registers	400
Copper-bearing steel	1,350
Coinage	950
Radio receiving sets	5,000
Clocks and watches (*g*)	4,500
Washing machines (*d*) (*g*)	4,700
Water heaters, household (*g*)	4,000
Water meters (*g*)	3,750
Refrigerators, electric (*d*) (*g*)	15,000
Plated ware (*g*)	8,000
Safety razors (*g*)	2,200
Radiators, heating	700
Other uses (*f*)	45,000
Manufactures for export (*e*)	49,900
Totals (*h*)	890,600

(*a*) Generators, motors, switchboards, lamps, and similar equipment, but exclusive of manufactures for telephone and telegraph purposes. (*b*) Transmission and distribution wire and bus bars. (*c*) Does not include electrical manufactures. (*d*) Does not include electrical generators or motors. (*e*) Includes all primary fabrications of copper and its alloys. (*f*) The estimates for these items are the least satisfactory entries in this table and must be viewed as being more conjectural than any of the others. (*g*) Included in other uses in prior years. (*h*) These totals are computed in the opposite way from those of deliveries, this line of figures emanating from consumers, whereas the line of deliveries emanates from producers. In view of the greater difficulty of accounting in the former way, the totals for manufacture are undoubtedly a little too low, probably about 5 per cent, for every year. In other words, the excess from manufacture should really be a little larger than appears in this table. For seven years, 1920-26, the total reckoned in manufacture is 4,913,283 tons, compared with 4,753,481 tons of deliveries. The difference is explainable in large part by the use of secondary copper by manufacturers that is not included in the deliveries by primary refiners. It is to be remarked, however, that the secondary smelters to a large extent produce black copper and blister copper that go to primary refiners and eventually figure in their deliveries.

* * *

Remedy for Hook-Worm Disease

"I should like to know an effective way of treating hookworm disease, which is quite prevalent among the miners of this section."

A simple treatment for this disease, which is so well known in warm countries, is given by K. Neville Moss in his "Gases, Dust and Heat in Mines." The procedure is to give a purgative of calomel in the afternoon and next morning three successive doses of 30 grains each (2 drams) of thymol, as emulsion or in capsules, at intervals of two hours. The patient should be confined to bed and allowed to drink tea or coffee only. On no account must alcohol, oil, or fats be given, as thymol is soluble in each and may thus become absorbed. After the last dose another purgative is given, castor oil being, however, avoided. Usually from two to three similar doses of thymol are necessary to effect a complete cure, Various other drugs having the property of killing the worm are used by medical officers in different countries.

If the existence of the disease is suspected, it is well to examine the men and exclude from the mines those affected. Proper sanitary provisions must be made underground. The workings should be kept as dry and as cool as possible by efficient ventilation.

By the Way

The Seismic Shareometer

THOSE geophysicists who descend at times from their Parnassian heights to take a flyer in the market will find something to interest them in the following, which appeared in a recent issue of the *Victoria (B.C.) Daily Times:*

To the Editor—One of the latest methods of ore finding is of interest. It is known as the "Seismic."

When a bomb is exploded the sound travels through the air, and the shock passes through the ground. The shock from about 150 lb. of dynamite buried approximately 6 ft. in the ground can be detected for many miles by a suitable shareometer recorder. This instrument records on a strip of paper moving at about 4 in. per minute, the markings being made by an instrument like a typewriter, the record showing both the arrival of the shock and the time of the explosion.

It has been found by experiment that the shock wave travels faster through an orebody than through earth or ordinary rock and from a properly constructed table it can be seen whether or not a large orebody exists. This method was recently made use of by the directors of the Ricopronto mine. They went to the mine and decided that the ore probably lay north 20 deg. east of the main adit. A hole was ordered to be sunk 6 ft. deep near the adit and a 150-lb. bomb placed therein and connected by wires with the firing battery.

A committee of shareholders who were augmented by the public were stationed several miles away at the shareometer recorder, at which there was also a board recorder. At a given signal the chairman of the company depressed a lever which exploded the bomb; in a matter of seconds the result was seen in the shareometer and recorded on the board recorder. It was seen that a large body of ore existed, and the delighted shareholders made evident their appreciation on the board recorder to the entire satisfaction of the directors.

ALBERT YOUNGS.

Victoria, B. C.

* * *

Yale Seniors' Opinion of Geology

COMMENTING on the results of the Yale senior questionnaire, a leader in the New York *Times* says that "The most significant item in the list is the poll on the Least Valuable Subject in the curriculum. Psychology carries off the leather medal with a triumphant 63, leaving economics with 28 and geology with 27 way behind in the ruck."

This verdict should prompt some interesting explanatory observations from geologists, both academic and practicing, from the all 'round mining engineer, and from the "man in the street."

INDUSTRIAL PROGRESS

The Sperry Concentrator

A Table Embodying a Novel Set of Principles

By Edwin A. Sperry

Pei-Yang University, Tientsin, China

SOME YEARS AGO the problem of cleaning large quantities of magnetite ore by hydraulic means was presented, and the first solution that suggested itself was that of the common riffle-strake. This was found to be thoroughly efficient, so far as the actual washing was concerned, after means were provided to give the riffle a short, lateral vanning motion. But inasmuch as it was necessarily intermittent in its action, it was hardly adaptable to large tonnage at low costs. To make the operation automatic and continuous, the riffles were positioned diagonally and at a moderate angle from the line of flow. This, in brief, is the history of the evolution of the Sperry concentrator. Several years have been spent in developing it from its primitive form. It has involved a series of simplifications and improvements until now the machine has proven itself to have remarkable efficiency both in capacity and recovery.

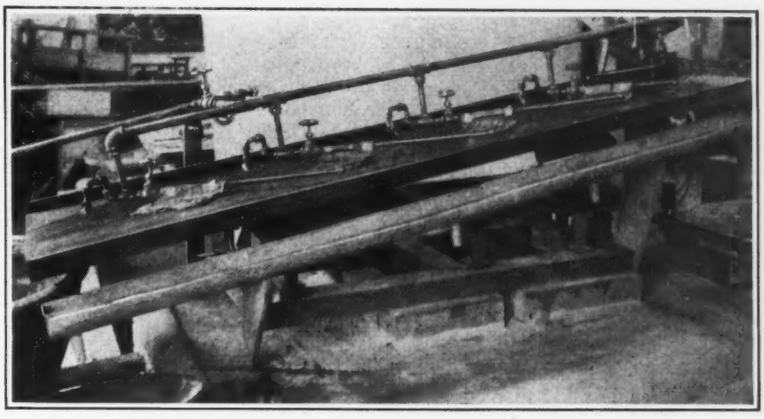
From the illustrations it will be seen that the deck is long and narrow, having a length four times its breadth. It has a comparatively steep slope in line with its length, the steepness of which can be varied to meet conditions. Diagonal grooves are cut in the surface, which are comparatively broad and deep at the higher ends and are made gradually narrower and shallower toward the lower ends, where they finally disappear on a line parallel to and a short distance from the concentrate discharge edge, leaving a narrow strip of plane surface, which is given a steep curving slope to assist in the discharging of the concentrate.

About 11 in. back from and parallel to the discharge edge, a flexible joint is provided along the entire length of the deck, with adequate means for tilting this 11-in. strip so as to create a retarding action, thereby causing a slight banking which controls the passage of material to the discharging zone or strip. A gentle flow or drip of water is used to keep the discharge strip thoroughly wet.

The function of the end-slope is solely that of causing the progress of the pulp from the feed end to the tails-discharge end. This, being entirely gravitational, is in perfect control. The degree of slope is adjustable and ranges from ¾ in. to 2¼ in. per foot, depending on the density and character of the pulp under treatment.

Inasmuch as the motion is applied only for the purpose of maintaining a perfectly mobile condition, in order to bring about a proper stratification, and for this reason alone, it is possible to employ a motion of a character best suited for this purpose. One that is short, rapid, and vibratory is undoubtedly the best. After considerable experimental work such a motion was adopted. It is horizontal and in line with the direction of the grooves, so as to promote the mobility of the concentrate minerals after settling. In connection with this horizontal motion the slope of the deck creates a slight jigging motion, because the plane of the motion is not coincident with the plane of the deck surface. This is a significant factor in the operation. It has been found that a throw of ¼ in. at from 400 to 500 r.p.m. is most efficient, the slower rate being used when treating ores of a quartzy, free-flowing nature and the more rapid with ores less readily kept properly mobile because of the presence of clayey or talcy material.

The high density at which the pulp is best operated is one of the remarkable features of this table. In the experimental work, low densities were used, at first, but it was soon observed that in all cases a stratum of pulp would settle on the surface of the table, which would be covered by a layer of water. It was necessary to lessen the end-slope so that this superimposed layer of water would not flow rapidly enough to wash off the pulp. The density was raised to a point where there was just an indication of a water film, and it was found that with a slope of 2 in. per foot, the pulp, under these conditions, was perfectly mobile and moved at a rate of from 8 to 9 in. per second. A sample of the pulp was taken and allowed to settle, and the density was determined. In all cases it was found to be between 60 and 65 per cent solids. As the normal saturation density was found to be approximately 70 per cent, the point was determined that the proper density of the pulp was from 5 to 10 per cent less than that of normal saturation for favorable results. Sixty per cent has been considered as a standard.

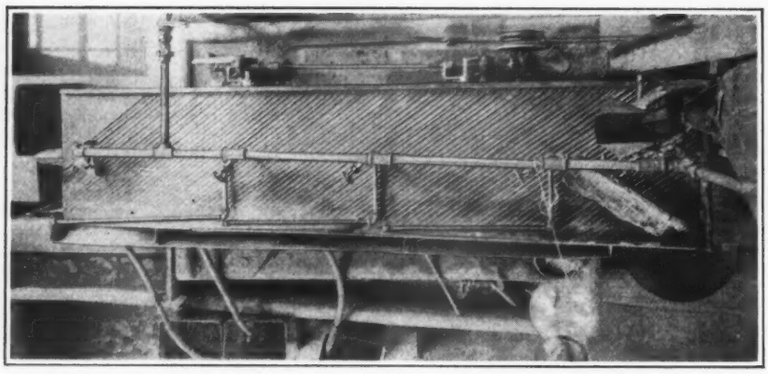


The Sperry concentrator equipped with spray pipes and diffusing cloths

Capacity of Table High

The high capacity of the table, relative to working surface, is another rather remarkable feature. This has been proven both by calculation and practice to be over 3 tons for each inch of width of feed. For example, a table having a deck 30 in. wide by 10 ft. in length will have a feed sole 19 in. wide, deducting the 11 in. for the finishing and discharging strip at the concentrate edge. The capacity of a table of this size will be approximately 50 tons in 24 hours. Assuming a pulp flow 19 in. wide, ¼ in. deep, moving at the rate of 19 in. per second, based on a 60 per cent density, the problem is easily solved.

Except for the 40 per cent of water



The Sperry concentrator from above. It is shown equipped with simple drip pipes at the concentrate edge and with one drip pipe and diffusing cloth at the head, with no brushing sprays.

in the feed, the only water used is just enough to keep the discharging strip perfectly wet, with a possibility of the addition of a small amount to regulate the mobility of the "bank." This additional water will not exceed 2 g.p.m. on a table of the size given.

To determine the actual necessity of water, a perfectly dry ore was run over the table. It consisted of quartz carrying pyrite having a crude value of 0.66 oz. per ton of combined gold and silver. An actual concentration of 3.2 to 1 was made against a possible ratio of about 10:1. The concentrate assayed 2.06 oz. per ton and contained 83.3 per cent of the values, which though giving a low-grade concentrate, shows a rather remarkable result, indicating that only enough water to promote a perfect hindered-settling action was needed and that practically no wash water, in the common acceptance of the term, was required.

Non-Dilution of Pulp

From the foregoing it may be concluded at once that whatever be the density of the pulp fed to the table, the same density will be maintained at the lower end where the tails are discharged, with the possible addition of a very small amount at the head for the purpose of controlling the mobility of the bank. This, at the most, can have but little effect on the final density, as a portion of it will pass over to the concentrate discharge edge. The advantage of this feature is so obvious that it needs no comment.

Operation

The general operation of the table is as follows: A pulp of, say, 60 per cent density is fed at the upper end in a stream 11 in. narrower than the entire width of the table. The rapid vibratory motion brings about a perfect mobility, or "quicksand" condition. The pulp moves down at the rate of 9 in. per second, and within three seconds, or a distance of about 2 ft., all the mineral concentrate has settled into the grooves. This fact has been checked many times. Inasmuch as the motion is not vigorous enough to cause a mixing action, and as no wash water is applied, the very finest of the mineral particles settle to the bottom of the grooves, in accordance with the action so clearly described by A. W. Fahrenwald in his article in the October, 1926, issue of *Mining and Metallurgy*. These concentrate minerals travel down the grooves, which, becoming narrower and shallower as they approach the concentrate discharge edge, will cause the overlying siliceous gangue to be scoured off. On reaching the retarding bank the heavier minerals will remain in the grooves and the lighter concentrate minerals will form an overlying bed. The heavy minerals will force their way over the "ridge" and pass off over the edge; the lighter minerals will pass down along the bank line, passing over the ridge in progressively increasing quantity until they are all discharged. As regards the slime mineral and its action, as before mentioned, the fact that it does settle to the bottom of the grooves has been indicated. On an examination of the grooves after a run has been made, this clearly appears to be the case. Also, after a run, it has been observed that films of slime mineral have spread out in fan shape from the points of the grooves on the plane surface of the discharging strip.

Results

Most of the experimental work has been done on a small table, 72 by 18 in., under rather unfavorable conditions, as will be readily recognized when the method of operation is explained.

A charge of from 5 to 8 kg. was made up with the predetermined amount of water and poured into the mixing hopper, at the head of the table. The mixer was allowed to run a short time, and the charge was then fed to the table, which had been put in motion. The length of the run was so short (usually but a fraction of a minute for the delivery of the pulp and not more than one minute for the completion of the run) that it was not only impossible to make any changes in adjustments, but, also, the normal condition could be observed only during the latter part of the run after the grooves had time to become loaded. This, naturally, resulted in low-grade concentrate. Even under these conditions the results were indicative. A few examples will be given.

In one test an ore contained galena and pyrite in a quartzy gangue assaying 7 per cent Pb. The first cut carried 60 per cent of the lead content of the charge assaying 45 per cent Pb; cut No. 2 carried 18.5 per cent of the lead assaying 37 per cent Pb, and cut No. 3 9 per cent of the lead assaying 25 per cent Pb. The combined product contained 87.5 per cent and assayed 40 per cent Pb. Another run on a similar sample showed 80 per cent of the lead in the first three cuts assaying 50 per cent Pb.

In a run on coal the ash was lowered from 25 to 15 per cent with a recovery of 89.7 per cent of the contained carbon. The feed was unsized minus-20-mesh.

In another run on an ore assaying 14 per cent Pb, the first cut assayed 62 per cent Pb, and 31.4 per cent of the product passed 150 mesh. The second cut assayed 50 per cent Pb and only 9.1 per cent passed this same mesh. This indicates the early delivery of the slime mineral.

Preparations are being made to carry out the experimental work under conditions more closely approaching actual mill work at the testing plant of the Colorado School of Mines at Golden, Colo., during the summer. A table having a deck 10 ft. by 30 in. will be used, from which results of a more practical nature can be expected.

Comparisons

In considering the development of this novel set of principles and actions it will be evident that they are at entire variance with and, in some ways, a direct reversal of, those developed in the Wilfley type of concentrator. A few comparisons may be of interest.

Progression and Stratification—These are taken together, as they are both brought about by one and the same cause in the Wilfley type—that is, the differential motion; whereas, in the new type, each of these actions is actuated and controlled by separate and distinct causes: progression by simple gravitational action and the stratification by a motion which is specially efficient for the purpose.

Pulp Density—In comparing pulp densities employed in the two types, there is no doubt as to where the advantage lies.

Pulp Dilution—The excessive dilution of the tailing, as occurring in the old type of table, is entirely avoided in the new, which must be acknowledged as an unquestioned advantage. In the old type all the wash water goes into the tailing discharge and amounts to from 10 to 20 g.p.m. at the rate of 15 tons of ore in 24 hours, or 1,400 gal. per ton, including pulp and wash water. In the new type the water used will not exceed 10 g.p.m. at the rate of 50 tons in 24 hours, or 300 gal. per ton.

Slime Saving—As shown in the foregoing analysis, conditions are such as to give every opportunity for the slime particles to settle to a position where they are perfectly protected and, as they are carried to the discharge edge in this protected position and not subjected to any washing action, they are favorably located for recovery. This action has been demonstrated in practice.

NEWS OF THE WEEK

Summary

SALT LAKE, Butte, Helena, and Great Falls, Western mining centers, will be linked by an air line now being formed. Four six-passenger planes will be put in the service. Page 667.

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American Zinc Institute, meeting at St. Louis, broadens scope of organization's functions. Page 666.

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Mining at depth on the Calumet lode, in the Michigan copper district, is being made easier by the haulage tunnel on the 81 level. The output of Calumet & Hecla's mines is taxing the company's mills. Page 669.

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Metal exports are being diverted from Tampico in increasing amounts as handlers at that port refuse to meet metal shippers' demands. Page 670.

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Dickens Consolidated, in the Coeur d'Alene district, has let the contract for its 200-ton mill and expects it to be ready for operation within four months. Page 668.

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Argonaut decides to close its Huronia property, in the Kirkland Lake district, after developments at depth prove disappointing. Page 667.

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New Jersey authorities urge construction of a building at New Brunswick, N. J., for the non-metallics division of the U. S. Bureau of Mines. Page 670.

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Anglo-Continental has sold its Nigerian tin properties to Anglo-Oriental, but may enter the British East African tin field if prospecting there produces results. Page 670.

* * *

Basque Mining & Milling, in the Sherman district of Nevada, is a small property which is making encouraging headway. The lower tunnel is being driven toward an orebody encountered on upper level. Page 669.

Canadian Royal Commission and Mine Operators Approach Agreement on Safety Regulations

Co-operation with Government Inspectors and Reforms in Practice Should Result from Inquiry Into Hollinger Disaster—Committee of Managers Now Studying Problem

THE adjourned hearing of the Royal Commission investigating the Hollinger disaster was held in Haileybury on April 12 to 14. At this hearing the mine managers were called together to consider certain suggestions of Judge Godson and of T. F. Sutherland, Chief Inspector of Mines for Ontario, as there is the possibility that these suggestions, if recommended by the commission, may be incorporated in the Mines Act. This was probably the most important gathering of Ontario mine managers ever held in Haileybury, as all of the important mines were represented and the managers present were in charge of companies having a market valuation of approximately $750,000,000.

Mr. Sutherland presented several suggestions, probably the most important of which were the ones dealing with the establishment of properly equipped central rescue stations at Sudbury, Kirkland, and Porcupine, the stations to be under the supervision of the local mine inspectors. Among the other suggested changes were the following:

1. That every underground foreman should hold a certificate certifying to his familiarity with the regulations of the Mines Act. Such certificate to be subject to cancellation by the inspectors, and managers employing foremen without certificates to be liable to prosecution.

2. That all foremen must be able to give and receive orders in the English language.

3. That no underground thaw houses be allowed. At present any underground thaw house can be installed only on a permit from the inspector, and the department purposes within a reasonable time to cancel all such permits.

4. That all underground repair shops and similar structures be fireproofed.

5. That all main ventilating fans should be located on the surface and should be reversible, and that the structures for all booster fans and auxiliary underground fans should be fireproofed.

6. That only one day's supply of oil and grease should be allowed underground.

7. That there should be a sufficient number of latched fire doors at every station to permit the shaft being completely cut off.

8. That there should be standard firehose equipment with water at 45-lb. pressure at every level.

9. That every mine should have up to date plans showing water connections and the direction of ventilating currents.

10. That all inflammable waste and rubbish should be taken to the surface.

11. That shift bosses and mine captains should certify once a week that there is no accumulation of combustible waste and rubbish underground in the territory under their jurisdiction.

Mr. Sutherland also made the suggestion that the commission should study the advisability of recommendations calling for the adoption of sprinkler systems at all underground crushers and in tipples and dry shafts; the placing of all high-tension electric cables in downcast shafts; underground telephones connected through at least two shafts; that pull-bell signals should be used as auxiliary in all shafts; that provision should be made for pumping stench chemicals into air lines for an emergency signal underground; the necessity for artificial ventilation and minimum quantities of air to be supplied to underground workings; provision for connection between adjacent mines to be used for rescue work in case of emergency; some regulation covering the distance that timber yards should be kept from shafts; question of installation of fire doors in shafts; question of minimizing the danger of fire hazard in underground transformers; regulations covering the transportation, distribution, and storage of explosives underground.

The labor representative also made suggestions that any man employed as mine captain should have not less than five years' underground experience; shift bosses, stope bosses, transportation bosses, or blasting bosses not less than four years' underground experience, and no man to be employed as foreman at any mine with less than three years' underground experience.

To give the mine managers an oppor-

tunity to study these suggestions the hearing was adjourned until the morning of the 13th. Upon the resumption of the hearing, the mine managers presented a general statement covering their attitude, following which the managers from all the camps were called as witnesses and were questioned regarding specific items.

The attitude of the managers was that they were anxious to co-operate with the commission and with the inspectors in every way to assure the safety of underground operations. It was pointed out, however, that if these suggestions were made into regulations they would apply to all mines alike, and on account of the greatly different conditions existing in every mine and in every camp it would be difficult, if not impossible, to frame definite regulations which could be put into effect without working a hardship under some conditions. Though they did not oppose a number of the suggestions, they questioned the advisability of having them adopted as regulations without some provision which would give the Chief Inspector or the Deputy Minister of Mines power to suspend the regulations where their operation did not appear practicable or feasible. They did not definitely oppose the adoption of some of the suggestions as regulations, but required more time to study them.

Inspector Has Wide Powers Under Present Mines Act

The present Mines Act gives the inspector wide powers to enforce any provision which he considers essential for the safety of the employees or of the operations, and practically all of the suggestions could be put into effect under these provisions. In this way the suggestions need only be enforced where they were considered advisable or essential. That mining in Ontario was a safe industry was also pointed out. In the 25 years during which the mines north of North Bay have been operating, and in the 40 years of operations in the Sudbury camp, the Hollinger disaster was the first one which had occurred, and it was considered that this was a record which would be difficult to duplicate in any industry having corresponding hazards.

The suggestion calling for the holding of certificates by foremen and the suggestion requiring a certain number of years' experience for different grades of foremen were definitely opposed. Suggestions 2, 4, 5, 9, 10, and 11 were approved, and there did not appear to be much objection to the incorporation of these suggestions as definite regulations.

Subsurface Thaw Houses Sometimes Safest

The question of underground thaw houses received a good deal of discussion, and the general feeling of the managers seemed to be that though they approved the suggestion in principle, there were certain conditions, such as in the congested sections of Cobalt or Kirkland Lake, where surface thaw houses might be more dangerous than underground thaw houses.

With regard to No. 6, it was considered that one day's supply of oil and grease was a restrictive limitation and that under proper conditions a reasonable supply of oil and grease represented a very small fire hazard. With regard to No. 8 it was considered that adequate fire-fighting equipment should be maintained at places where the inspector considered it advisable.

The question of latched fire doors at every station and of the equipment and maintenance of central rescue stations at Sudbury, Porcupine, and Kirkland was also discussed at considerable length. The managers, however, considered that they should have more time to study these particular suggestions, and a committee of the operators consisting of two managers from each camp was appointed by the Judge to study the question and bring in a report.

Mr. Sutherland's other suggestions to the commission were also given consideration, but the general opinion seemed to be that these should not be adopted as definite regulations but should be matters of agreement between the managers and the inspectors, to suit the different conditions.

In concluding the main hearings of the commission, the Judge expressed his appreciation of the spirit of co-operation shown by the operators, which was manifested by the manner in which they had turned out to the hearing and their willingness to give evidence. He requested that the committee of operators should bring in its report as soon as possible and suggested that their further conference should be held in Toronto.

American Zinc Institute Broadens Form of Organization at St. Louis Convention

Ralph M. Roosevelt, of New York, Elected President, With Stephen S. Tuthill and Howard I. Young Continuing as Secretary and Treasurer—Mining, Smelting, and "Brothers-in-Law in Business" Discussed

Reported by John S. Potto
Special Telegram to Engineering and Mining Journal

St. Louis, April 17.—Ralph M. Roosevelt, of New York, vice-president of the Eagle-Picher Lead Company, was elected president of the American Zinc Institute at a meeting of the board of directors this afternoon. He succeeds Jesse G. Starr, of Joplin, who declined re-election, but who automatically becomes first vice-president. P. B. Butler, of Joplin, was elected a vice-president and John A. McCarthy, of New York, was re-elected. The retiring vice-presidents are A. P. Cobb, of New York, and Julius W. Hegeler, of Danville, Ill. Stephen S. Tuthill, of New York, who has been secretary of the Institute since its organization ten years ago, was re-elected, as was Howard I. Young, of Mascot, Tenn., who is the only treasurer the Institute ever has had. There was only one change in the board of directors, Edgar L. Newhouse, Jr., of New York, succeeding Alexander J. McKay, of Lasalle, Ill., who resigned. An important step taken by the board of directors was to amend the bylaws of the Institute so as to increase the powers of the executive committee, and to make the organization of the Institute comparable to that of large industrial corporations.

Probably as important a session as the Institute has ever held was that of this forenoon, when the subject of zinc coating, or "galvanizing," as it is more commonly known, was discussed. For the first time several of the larger galvanizing concerns of the country had accepted invitations to send representatives to meet with representatives of other branches of the zinc industry under the auspices of the Institute. The session was presided over by F. G. Wallower, of Joplin, chairman of the Institute's Galvanizing Committee. One of the principal addresses was delivered by Harry S. Rogers, of the Sheet Steel Trade Extension Committee, on the subject of "Brothers-in-Law in Business." The Institute's annual dinner was held tonight with Captain Irving O'Hay, of New York, as the principal speaker. The forenoon session tomorrow will be devoted to a discussion of subjects pertaining to smelting, and the afternoon session to subjects pertaining to mining. The convention opened yesterday morning at the Hotel Statler, and for the first time is occupying three days instead of two.

Many mayors are scheduled but few appear. Usually they send substitutes with last-minute regrets. However, Mayor Victor Miller, who happens to have grown up in the shadow of the chat piles of Joplin, personally welcomed the delegates. The response was made by Henry S. Wardner, of New York, general counsel for the New Jersey Zinc Company, and the oratorical exchange of the two gentlemen will be remembered as one of the high lights of the convention.

Dr. Hugh P. Baker, of the United States Chamber of Commerce, addressed the convention in the afternoon on the subject of "Trade Associations and Their Work." Other addresses were on trade topics. A smoker was given in the evening.

Air Line Now Being Formed Will Connect Western Mining Districts

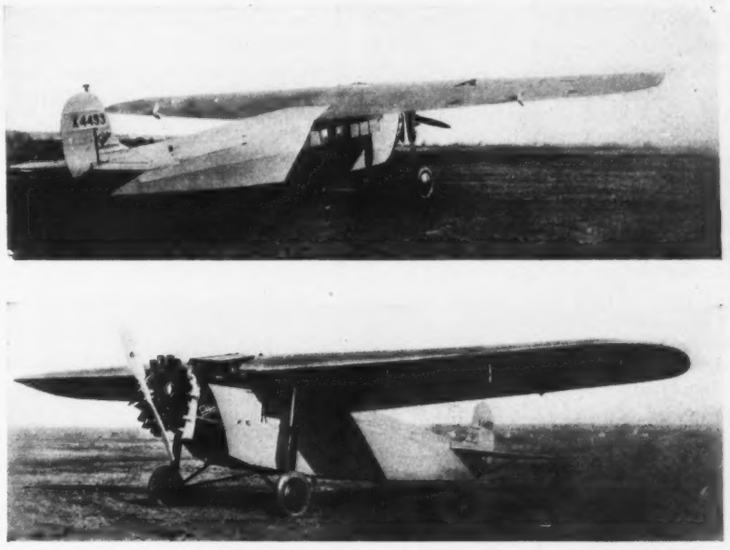
Passenger and Mail Planes to Give Daily Service Over Salt Lake City, Pocatello, Butte, Helena, and Great Falls Route

KEEN interest is being taken by Western mining men in the establishment of a new air line that will be placed in operation about the middle of June over a Salt Lake City, Pocatello, Butte, Helena, and Great Falls, Mont., route. Operation of the line will be in charge of National Parks Airways, Inc., recently organized by Alfred Frank, vice-president of the Keystone Mining Company, who is manager of the new air line company. The schedule of operations provides for one daily trip each way over the route, with stops at all the points mentioned. Equipment of the company will include four large six-passenger Fokker planes, now being completed by the Atlantic Aircraft Corporation at Hasbrouck Heights, N. J.

Besides supplying aërial passenger-transport facilities, the company has also taken over, and will operate under, a contract with the Post Office Department to carry air mail over the route. As the line will connect with the already established and successful transcontinental air mail lines passing through Salt Lake City, it will provide a new and valuable mail service to the numerous mining companies operating at the terminal and intermediate points of the route and in adjacent districts.

In comparison with travel by railroad, the line will enable officials of the mining companies, as well as the general public, to conserve their time materially. The trip between Salt Lake City and Great Falls, Mont., will require only 5½ hours, or less, whereas train time between these points is 25 hours. Butte, a 17-hour trip by train from Salt Lake City, will be reached in 3½ hours, and the Butte-Helena and Butte-Great Falls hops will be made in 40 minutes and 2 hours, respectively, as compared with 3 hours and 7 hours by train.

Associated with Mr. Frank as stockholders in the new air line are the following mining men: L. S. Cates, of the Utah Copper Company; J. O. Elton and J. B. Whitehill, of the International Smelting Company; W. J. O'Connor, American Smelting & Refining Company; T. F. Kearns and David Keith, Silver King Coalition Mines Company; Chauncey L. Berrien, Anaconda Copper Mining Company; W. N. Rossberg, Clark interests; and others.



Two views of the type of airplane to be used on the Salt Lake-Great Falls route

Argonaut Mines Ceases Operations at Kirkland Lake

THE management of the Argonaut Consolidated Mines, Ltd., has decided on a cessation of operations at the Huronia property, in the Kirkland Lake area of northern Ontario, owing to unfavorable geological developments at depth. According to report, the mill will be closed down, obligations discharged, and a statement prepared which will be submitted to a special general meeting of the shareholders to decide on the program for the future. The report of the company's superintendent, David R. Thomas, after setting forth in detail the results of operations, concludes as follows:

"The two lower levels have proved very disappointing. A small amount of ore was found on the 1,125 level, but none on the 1,250 level, with the exception of a small stringer in diamond-drill hole 63. A big mass of intrusive rock appeared on the 1,250 level, which cuts out orebodies in the eastern section of the mine and makes further developments very costly. In view of the adverse geological and structural conditions encountered in the bottom of the mine, I feel reasonably sure that the mine will never prove profitable, and therefore recommend that operations be suspended and the mine abandoned."

In addition to the Huronia, the company owns 27 claims in Ontario and 8 claims in Dasserat, Que.

New Mill to Be Erected at Rosebery, Tasmania

Electrolytic Zinc Company, of Australia, has selected Rosebery as the site for the new mill which will treat the ores from the Read-Rosebery mines, on the west coast of Tasmania. The mines were purchased from the Mount Read & Rosebery Mines, Ltd., in 1925, and carry lead-zinc sulphide ore. For several years, Electrolytic Zinc has operated an experimental mill at Zeehan, and this will continue to be used, pending construction of the new mill.

Gypsum Company Formed to Erect Plant in Montana

Montana Gypsum Products Company has been incorporated in Montana for the purpose of erecting a 100-ton crushing and sacking plant at Lima, Beaverhead County, Mont.

United Gold Buys Properties in Boulder District

UNITED Gold Mines has acquired control of the Osceola, Inter-Ocean and White Crow mines, in the Boulder district of Colorado. It is understood that the dumps contain considerable quantities of recoverable gold. United Gold owns properties near Independence, Colo., in the Cripple Creek district.

Sinking of the shaft of the New El Paso Mines, Inc., at its Plutocrat mine, in the Cripple Creek district, is proceeding toward the 200 level. A. F. Woodward, vice-president and general manager, is supervising operations. New El Paso also owns the El Paso mine, which adjoins the Plutocrat.

Continental Chief Silver-Lead Mines, recently formed to take over the Continental Chief mine, in Iowa Gulch, Leadville district, Colo., has started development operations. The mine has been idle for some time.

O. B. Willmarth, general manager of Prize Mining, says that operations will be resumed at the company's property in the Blackhawk district, Gilpin County, Colo. Development will be by the Newhouse tunnel and from the surface.

Canario Copper Promoters Held for Fraud

SEVEN of the ten men indicted with the Cameron-Michel Company, Inc., were held for trial on April 16 by Federal Judge Goddard of the New York district court. They were indicted on a charge of using the mails for the purpose of selling stock in the Canario Copper Company. It is alleged that the men, through the agency of the Cameron-Michel Company, a brokerage organization, defrauded stock buyers of $7,000,000. Canario Copper was organized under a Delaware charter with a capitalization of $20,000,000 in par $10 shares. The stock was traded in for a time on the New York Curb, but was suspended from trading in 1925. It subsequently was traded in over the open market. The company was supposed to be a holding corporation, owning all the stock of the El Canario Consolidated Copper Company, which owned three groups of claims near Nacozari, Sonora, Mexico.

George F. Shurtleff, president of the company; and Herbert C. and John T. Locke, both directors, were released in $10,000 bail. Stock salesmen and other employees were released for smaller amounts.

Cameron-Michel was originally organized by U. S. Senator Ralph H. Cameron, of Arizona, but he left the firm before the alleged irregularities took place, and no blame whatsoever is attached to him.

Basin-Montana Tunnel Will Develop Grey Eagle Group

FOLLOWING the announcement of the financial reorganization and reopening of the old Jib-Hope-Katie group, at Basin, Jefferson County., Mont., information is received that Basin-Montana Tunnel, which controls 74 claims on Comstock Hill in the Basin district, is being financed. Included among the properties owned by this company is the Grey Eagle group, carrying gold, silver, lead, zinc, and copper ores. Development in the past was for the gold and silver content, but operations ceased because of the presence of zinc, which at that time had to bear a smelter penalty. With modern metallurgy it is believed that the ore will be commercial at depth. Present plans involve tapping the veins by a crosscut tunnel. The portal of the tunnel will be close to the Great Northern Railway tracks and on the main Butte-Helena highway. The property is situated two miles east of Basin. Mining operations will be conducted under the supervision of Samuel Barker, consulting engineer of the Butte Copper & Zinc Company.

Doris Mining, another Basin property, recently reached its orebody in a tunnel 115 ft. below the winze, where ore was encountered in the upper workings. Zinc, lead, and silver are present in the ore.

Modern Methods May Revive Virginia Gold Fields

REPORTS from Richmond, Va., indicate that modern machinery and treatment may revive the gold fields of Virginia, said to be the oldest in the United States. The gold belt extends from Montgomery County, Md., to the North Carolina-Virginia boundary. Before the Civil War there were 114 mines in the field. As a result of the damage done during the war, and also because of the elimination of cheap slave labor, the mines were forced to cease operations, although records of the Philadelphia mint indicate that the Whitehall mine, situated in this district, sent bullion to be minted as late as 1881.

One of the first indications of the presence of gold in Virginia occurs in the writings of Thomas Jefferson in which he refers to the finding of a nugget near Fredericksburg, Va., about the year 1772.

140,000 Lb. of Explosives to Be Used for Two Blasts on Michigan Iron Range

Preparations are being made at the Volunteer mine of Pickands, Mather & Company on the Marquette (Mich.) iron ore range for two large blasts, which are expected to loosen about 450,000 tons of ore. It was originally planned to shoot the 700 6-in. churn-drill holes, loaded with 5-in. sticks of gelatine dynamite, at once, but a change has been made, and there will be two separate shots. The first will require about 75,000 lb. of powder; the second, about 65,000 lb. Both blasts will be fired this month. Last spring two large shots were fired in the same pit, and the results were satisfactory.

Dickens Con. Awards Contract for 200-Ton Concentrator

CONTRACTS were let on April 10 by Dickens Consolidated, operating properties in the Cœur d'Alene district, to W. L. Zeigler, of Gem, Idaho, to proceed with the construction of a 200-ton concentrator at a cost of approximately $60,000. The mill is expected to be in operation within the next four months. At a recent meeting of the board of directors of the company it was decided to finance the enterprise by direct assessment of the shareholders rather than have it financed by outside interests. The raise connecting the 400 and 500 levels of the mine is said to have disclosed the best ore showing ever made in the property.

Keystone Mill at Lead, S. D., Will Be Finished June 1

KEYSTONE Consolidated Gold Mines is finishing its new mill of 125 tons' capacity at its properties in the Lead district of South Dakota. It will be a cyanide mill with plate amalgamation, recovering the coarse gold before cyaniding. The company owns the Columbia, Holy Terror, Keystone, Bullion and Lucky Boy mines. It is doing most of the work now on the 300 level of the Columbia. Ore from three Columbia levels and also from the Bullion mine will be used to feed the mill while development proceeds on the other properties. The power for mining development is generated by a 350-hp. Fairbanks Morse Diesel engine.

Spokane Silver & Lead, in the same district, has installed a 2,300 volt generator at its steam plant, which has been re-equipped after a fire which occurred in January. The flotation mill of 100 tons' capacity installed last year is working satisfactorily.

Hazel Silver Mine in Texas Being Unwatered

Unwatering the Hazel silver-copper mine, situated near Van Horn, Culberson County, Tex., is being done by the World Exploration Company of Fort Worth, which recently acquired the property. Eight thousand tons of ore is being shipped from the dump to the A. S. & R. smelter at El Paso.

The Hazel mine was worked for several years by Texan interests and produced approximately $600,000 worth of ore, but it was shut down in 1895 following the drop in the silver price from about $1 an ounce to 65c. It is reported that 90,000 tons of ore have been blocked out in the lower levels. The main shaft is 746 ft. deep.

Construction of Grandview Mill to Start Soon

GRANDVIEW Mines, which owns properties in the Metaline Falls district of Washington, has let a contract for the construction of a mill. A payment has already been made for the erection of the buildings. According to a statement made by Guy E. Riegel, a director of the company, the buildings will be steel and will be fireproof. Ore treatment will be by flotation, after reduction by fine grinding in ball mills and classifiers.

The properties of the Grandview company are situated opposite those of Pend Oreille Lead-Zinc. Discovery of what are said to be large bodies of lead-zinc ore in the Metaline Falls district has attracted considerable attention in the Northwest recently.

Z-Canyon Lead-Zinc recently started is second vertical diamond drill at its properties, adjoining the Grandview claims. The first drill hole is now down 240 ft.

Haulage Tunnel Makes Mining at Depth Easier at Calumet & Hecla

Milling Plants of Michigan Copper Producer Are Being Taxed by Output From Company's Mines—May Necessitate Reopening of Osceola Mill

MINING of the Calumet lode of Calumet & Hecla Consolidated, in the Michigan copper district, is being made easier by the haulage tunnel on the 81 level of the conglomerate departments. Almost as much tonnage is coming from below the haulageway as from the levels above and it is expected that this advantage will increase with the deepening of the two working shafts, No. 4 Calumet and No. 7 Hecla. Stoping operations are under way on five or six levels at the "A" shaft, as No. 7 Hecla is known below the 81 level.

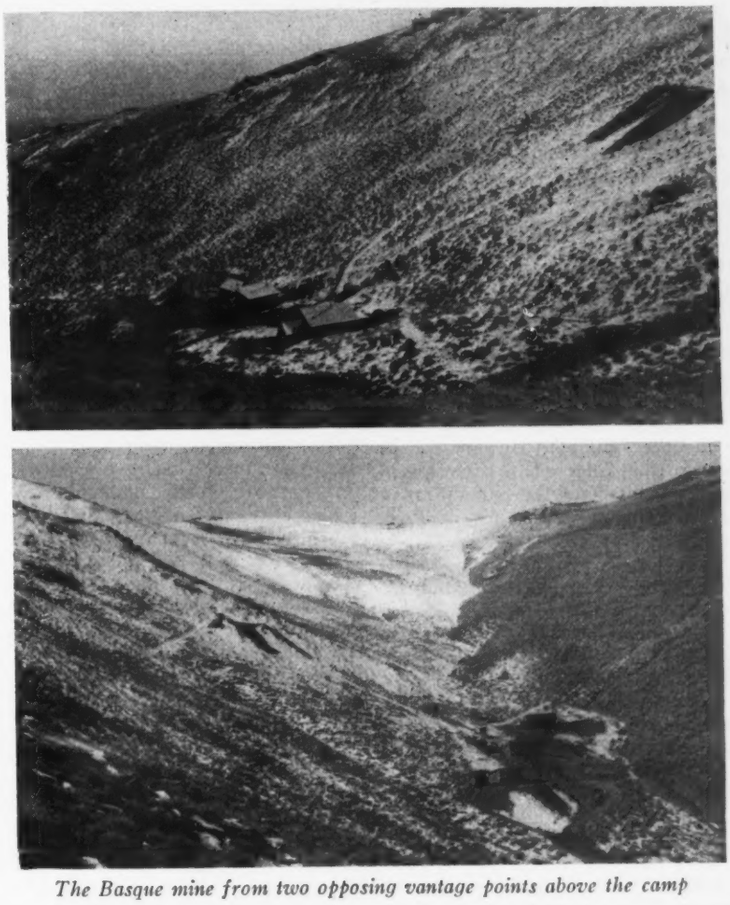
If there is much increase in tonnage from the company's mines it may be necessary to put either the Osceola or Little Tamarack milling plants into operation. Both are said to be ready for immediate use. Calumet and Ahmeek mills are being taxed to capacity. The Hecla mill, which has been idle for some years, is not a modern plant, and there is little likelihood of its being used. About 4,000 tons of high-grade amygdaloid rock is being shipped to the Ahmeek mill daily. Most of this is from the Ahmeek mine, a small tonnage coming from the North Kearsarge openings. Rock from the four active shafts on the Osceola lode is being sent to the Calumet and Ahmeek mills. No. 17 shaft will probably be reopened after a new hoist is installed, making five shafts handling Osceola rock. The rock house will probably need repairs, also, but the shaft itself is believed to be in good condition.

Results of operation of the company's Lake Linden and Tamarack reclamation plants during 1927 have been made public. These plants recover copper from the waste conglomerate sand. Costs decreased from 7.10c. a pound in 1926 to 6.63c. in 1927, and, of the copper recovered, 62 per cent was obtained through leaching, compared with 58 per cent during the preceding year. Total amount of copper reclaimed by the plants since they started in 1915 amounts to 187,392,000 lb. of refined metal. It is said that the production of the reclamation plants is greater than that of any amygdaloid property in the Michigan copper district with the exception of the Ahmeek mine.

Isle Royale Is in a Position to Maintain High Rate of Production

With consistently commercial copper ore in both of its working shafts, Isle Royale is in a position to maintain its high rate of production. Yield is close to 25 lb., refined, per ton, and the output of approximately 1,000,000 lb. per month is the best in the history of the property. No. 4 and 5 shafts are bottomed at 4,000 ft., which is comparatively shallow for Lake mines. In both of these units, Isle Royale has a long life, and as mineralization has been uniform at depth, the future appears promising. Both shafts are kept well opened in advance of requirements, and new openings are well mineralized. Isle Royale is well equipped in every department and has no construction charges to meet. The prospects are that it will probably receive in 1928 an average price of better than a cent a pound more than was received for its metal last year.

The labor situation in the Michigan copper district is most satisfactory, and it has enabled the mines to build up their forces to an adequate, efficient basis. Most of them now have waiting lists.



The Basque mine from two opposing vantage points above the camp

Development to Expand at Basque Mine

GOOD progress is being made in extending the lower tunnel of the Basque mine, situated 23½ miles north of Winnemucca, Nev., in the Sherman district along the Bloody Run mountain range in Humboldt County, according to J. S. Brereton, vice-president of the Basque Mining & Milling Company, which is operating the property. It is estimated that in another 240 ft. the lower tunnel will encounter the extension of the high-grade vein exposed a year ago in the upper tunnel. This tunnel, which was driven a total distance of 640 ft. by the Basque brothers prior to May, 1927, when the Basque company took over the property, has been abandoned, as it has so many twists and turns that further economical development from it was impossible.

Two shipments of quartz-gold ore, one a carload and the other less than carload, were recently made from the property. At present a crew of six men is employed, but it is planned to put on another shift within 30 days. Operation of the property by the Basque company has been continuous since May 15, 1927.

Two views of the camp are shown in the accompanying illustrations. The dump at the portal of the upper tunnel is seen on the mountainside, and the dike outcrops are visible behind it in one view. The portal of the lower tunnel is in the rear of one of the lower two surface buildings.

At a recent annual meeting of the company, the following officers were re-elected: Frank Brereton, president and manager; J. S. Brereton, vice-president and secretary; and B. J. Loinez, treasurer.

London Letter

By W. A. Doman
Special Correspondent

Anglo-Continental Has Sold Its Nigerian Properties to Anglo-Oriental

London, April 3, 1928 — At the annual meeting of Anglo-Continental Mines last week, W. F. Turner, chairman of the board, announced that the company had disposed of its Nigerian tin interests to Anglo-Oriental & General Trust. Anglo-Oriental is the company backed by John Howeson which has recently effected the consolidation of several tin companies through the agency of Associated Tin Mines. Mr. Turner gave as the principal reasons for the sale of the properties the fact that some of them had resulted disappointingly and that it is much more difficult to find paying ground on the Bauchi plateau today than it has been in the past. The Anglo-Continental has dispatched a prospecting expedition to British East Africa under the direction of A. Basil Reece, accompanied by an assistant engineer. Both of these men were in the company's service in Nigeria, so it is inferred in some quarters that the object of the expedition is the purchase of tin properties in East Africa.

THE ANNUAL report of Globe & Phoenix Gold Mining is again a matter of surprise. This Rhodesian property continues year after year with virtually the same result, when, according to some prophets, it should have been exhausted long ago. Apparently during the last year a remarkable run of ore opened up about two years previously was drawn upon, and pillars containing high gold content were removed from the northern edge of the stoped area between levels 16 and 20. C. B. Kingston, the company's consulting engineer, puts the ore reserves now available at 55,667 tons, averaging 21.9 dwt.; and an additional 45,334 tons averaging 31.3 is contained in the pillars. Last year 73,138 tons of ore was treated.

As regards some of the mines of the Rand with development faces less numerous, and ore reserves being encroached upon, or only just maintained, hopes have been held out in the past, and still are expressed, that thin reefs known as the upper leaders will provide substantial quantities of ore. These quantities do not appear to be forthcoming, however, for an examination of reports that have just reached London indicates a fairly extensive development footage, a relatively high cost, and only moderate results. However, small additions are useful when the aggregate is declining.

Dome Corporation, operating in northern Spain, has not yet made a success of its property on the Orbigo River. It has had the concessions returned by the Dredging Development Company, whose operations suggest that the ground warrants a large powerful type of dredge. The Dome dredge, though it has been improved, is still deficient in power, and further capital is required.

According to a message from Paris, prospecting operations on the quartz deposits at Grandry, in the Nievre department of central France, have disclosed ore showing 52 grams of gold to the ton, and some silver. The government is interesting itself in the discovery, and its mining representatives are said to be in favor of search on an extended scale.

Washington Letter

By Paul Wooton
Special Correspondent

Building at New Brunswick Urged for Non-Metallic Research Division

Washington, D. C., April 16, 1928 —Headed by Dr. Henry Kummel, New Jersey state geologist, a party of New Jersey officials descended upon Washington last week with a plan for the expansion of research work on the non-metals now being conducted at the U. S. Bureau of Mines experiment station at New Brunswick, N. J. The proposition involves the erection of a special federal building for the purpose. Rutgers University will, according to report, donate a portion of its campus if the building is approved.

Representative Hoffman, who represents the New Brunswick district in Congress, will introduce a bill providing for the new building and will urge that Congress make adequate provision for research work on the much-neglected non-metallic minerals. His idea is that this station be made the center of research for the mining industry in the eastern states.

All of the Bureau's research and experimental work on potash has been concentrated at the New Brunswick station. Important work has been done on anhydrite and on other non-metallic materials. It was here that the wire saw for cutting slate was developed.

Since March 1 the Bureau of Mines has been unable to send members of its staff to the conventions of the technical and other societies dealing with the problems of the mining industry, as the appropriation for the purpose was exhausted on that date. Congress placed a limit of $2,000 on the expenses which might be incurred for attendance at such meetings. Sight evidently was lost of the fact that it is at such gatherings as these that the Bureau is enabled to learn of the progress which is being made by the industry and to get a better idea of the assistance the federal government can render best.

Mexico City Letter

By W. L. Vail
Special Correspondent

Metal Exports Diverted From Tampico as Freight Rates Are Not Changed

Mexico City, April 10, 1928— Efforts to regulate the differences between the metal shippers who have been using the port of Tampico and the Tampico organization of handlers, known as the Empresa de Maniebros Maritimas, have not passed beyond the conversational stage. It is understood that a small discount from the present charges for loading was suggested, but shippers insist that at least a 50 per cent reduction under prevailing prices would be required to make resumption via Tampico practicable. The present charge is 3.70, Mexican pesos, compared with 45c., American money, by rail to Corpus Christi or Galveston, Tex. Practically all the ores or metals shipped from mines in northern Mexico have gone through Laredo, Tex., for the last six weeks.

DEFINITE returns for mineral output throughout Mexico for the first three months of the present year have not yet been tabulated, but the Department of Mines reports an encouraging situation in metal mining, with the possible exception of zinc. Unfavorable prices for this metal may result in the closing of a number of properties. Silver and mercury will probably show increases over the output for the last three months in 1927. There have been many applications for concessions to explore and exploit mineral areas, and a number of properties recently declared open for re-denouncement have been taken up. Bandit activities have interfered with very few operations, the government appearing to have the situation well in hand.

Efforts are still being made to induce some modification in the mining laws, put in force May 3, 1926. Under the present regulations, the discoverer of mineral lands is prohibited from disposing of any ores, pending a final concession, which is given for a maximum of 30 years. Transfer of rights acquired under concession can be made only by permission of the Secretary of Commerce, Labor, and Industry. The number of claims which may be held by one party or company is limited, and a minimum amount of work must be performed to retain ownership of the claims. Those advocating modification say that these provisions seriously retard the work of the prospector.

Operations of the San Rafael company at the Veta Grande properties in Chihuahua are being limited to exploration. Paying ore is reported to have been found at greater depth than expected, and exploration is proceeding in the lower levels.

Southwest Seeks to Promote Increase of Mining Development

Representatives of Arizona and California Industries Unite to Give Publicity to Region's Latent Possibilities—Civil and Educational Officials Co-operate

By George J. Young
Associate Editor

MINERS and Chamber of Commerce representatives of San Diego County, Calif., and Yuma County, Ariz., held a mining meeting at Yuma, Ariz., on March 31. The objective of the meeting was an inquiry into what can be done toward increasing mining activities in the extreme southwest corner of the United States. Actually, the "selling" of the mining industry to the local public and to others was in the foreground, and, as in other meetings of a similar character in other Western localities, this is the important function of such meetings.

Dean G. M. Butler of the University of Arizona opened the Southwest meeting, which was attended by about 50 people. Dean Butler discussed the work of the Arizona Bureau of Mines, stating that this bureau identified mineral substances and rocks for prospectors and others in Arizona and was engaged in geological investigations of mineral districts. J. E. Morrison, of the San Diego Chamber of Commerce, stated that the organization of a Chamber of Mines in San Diego County for the purpose of finding facts about mineral deposits was accomplished through arousing local banking interests and others to the possibilities of mineral development. As a result, the output of mineral products during 1927 in San Diego County had been increased to $2,000,000 in gross value and it is expected to increase this to $10,000,000 in five or six years. Mr. Morrison cited this as an illustration of what can be done by liberally supporting a program of development.

Michael Curley, of New Cornelia Copper, reviewed the early history of mining in Arizona and in particular brought out the early difficulties of the Ajo enterprise, which began in 1911, and its present importance as well as its significance to the state from the standpoint of payroll and taxes. About 950 men are employed, and the district pays 40 per cent of the taxes of Pima County. A total of $947,763 was paid in taxes in 1927. The operation of co-operative non-profit stores was described. Mr. Curley stated that since these stores were started by his company, in 1917, more than $445,000 had been rebated to employees. A consistent effort is being made by the large mining companies to make their purchases of supplies and other commodities within the state as far as possible. Mr. Curley said that there were fourteen major operating companies; eight smelters, of which two are shut down; nine concentrating mills; and two leaching plants in Arizona. Approximately 18,000 men are employed, and $28,000,000 is the annual payroll. The mining industry pays over 42 per cent of the state's taxes. He also spoke about the extension of ore reserves resulting from improved recoveries and mentioned the record made by Miami Copper. In concluding he said that every mining company in the state is trying to find a new mine.

W. B. Tucker, of the California Mining Bureau, briefly described the mineral resources of Imperial and San Diego counties. He said that the region is rich in non-metallics. Douglas Clark, of the geological department of the Southern Pacific Railroad, described the work of his company in investigating and listing mineral deposits in the region, as well as seeking to interest manufacturers in the raw products available. He mentioned the cyanite deposits near Ogilby, Calif., and fluorspar of the Castle Dome district, in Arizona; and stated that the completion of the new Gila River bridge near Dome, Ariz., will result in greater mining activity in that region. Dean Butler closed the morning session with a brief résumé of the possibilities of geophysical methods in the discovery of mineral deposits.

Importance of Mining to Arizona

At the afternoon session, P. G. Spilsbury, of the Arizona Industrial Congress, presided. In opening the meeting he said that 76,000 of the total population of Arizona derived their support from the mining industries, which are credited with a purchasing power of more than $100,000,000 per annum. The importance of these industries in stabilizing the business of the state was stressed. The mining companies had pledged their purchasing power first to Arizona and second to southern California. Mr. Spilsbury pointed out the value of mineral development to the various business communities.

H. J. Bishop, ore buyer of the Phelps Dodge Corporation, called attention to the fact that his company is operating the only lead smelter in the state and is in a position to afford a market to the small producer. W. B. Gohring, secretary of the Arizona Chapter of the American Mining Congress, said that cultivating the interest of bankers in mining is important. Mining is of major importance in Arizona, but less so in California. As a result of activity in lead and zinc prospecting, Mr. Gohring said that there was prospect of a great growth in lead production in Arizona. He pointed out the fact that of present metal production about 68 per cent is derived from low-grade ores that in 1909 were considered to be waste. It is to the interest of everyone to build up the mining industry of Arizona. Dean Butler described the mining districts of Yuma County and touched upon their past history and production. He said that although the present production of Yuma County is small, it has a bright mining future and mining in that region should be encouraged.

Mr. Spilsbury brought out the fact that the old-time saloon keeper was often the source of the prospector's grubstake and had therefore contributed to the development of mining. He then called upon the prospectors present to address the meeting. Frank Ewing told about his success in developing a gold prospect and expressed his opinion that "our end of the country needs a lot of development." Sam Ash stated that he was developing a prospect in the Castle Dome district. W. H. Trenton spoke about numerous prospects and inability to obtain money to explore them. P. Skelton called attention to the financial hardship involved in paying the $10.70 per $100 of payroll required by compensation insurance and the need for a reduction in this charge. Tom Foster, state mine inspector, moved a vote of thanks to the fast-vanishing prospector for the part played by him in discovering Western mines. Another prospector said that the absence of water in certain areas precluded prospecting and that some efforts should be made to store water in the canyons by building small dams to form water holes. The need for roads and better transportation was discussed.

In closing the meeting, Mr. Spilsbury said that the mining problem is before Yuma and Imperial counties and is of sufficient interest to warrant active co-operation from business men and others.

Missouri School of Mines Offers Four Fellowships in Ore Dressing

IN CO-OPERATION with the U. S. Bureau of Mines and the state mining experiment station, the School of Mines and Metallurgy of the University of Missouri offers four fellowships. These fellowships are open to graduates who have the equivalent of a bachelor of science degree. The income of each fellow is $800 for ten months beginning Sept. 1, 1928. The purpose of this work is to undertake the solution of definite problems confronting the mining and metallurgical industries of the State of Missouri. For 1928-1929 the four fellowships will be granted in the following subjects: Ore Dressing: problems in gravity concentration and flotation. Applications should be accompanied with a certified copy of collegiate record, statement of professional experience, and names and addresses of three references. They must be received before June 15, 1928, and addressed to the Director of the School of Mines and Metallurgy, University of Missouri, Rolla, Mo.

Book Review

"Cousin Jack" Himself

THE CORNISH MINER. By A. K. Hamilton Jenkin. An account of his life above and underground from early times. George Allen & Unwin, Ltd., London. Price $3.

THE REVIEWER started to read this book with sympathetic interest, which could hardly have been more keen if the author had been a personal friend, for indeed there was an old friend, and kinsman, involved, and that was the "Cousin Jack" himself, the hero of the story that Mr. Jenkin has told with such insight and intelligence. The author himself is full of the romance of his subject, and it will gratify him to be told that the question put modestly in the first paragraph of his preface, as to whether he has "passed over the footlights" any of his own enthusiasm, will be answered by his readers, I feel sure, with a cordial affirmative.

The book begins with a glance at the traditional and prehistoric features of mining in Cornwall, including appropriate references to the Phoenician tin trade and Roman exploitation. Our author, however, recognizes the dubious character of the classical evidence and refuses to expatiate on this phase of his subject, concerning which the reviewer can assert that the Cassiterides, the fabulous tin islands of Herodotus, were not the Scilly Isles, as the Encyclopaedia Britannica says, but Cornwall itself, for in ancient days all remote places were "islands" to the Greeks. No proof exists that the Phoenicians went direct to Cornwall, nor even to the island of Ictis, which has been identified with St. Michael's Mount, near Marazion, but it seems probable that the men of Carthage and Gades obtained the Cornish tin through barter with the Veneti, the people that lived in what is now Morbihan, at the mouth of the Loire. These Veneti, whom Caesar subdued before his invasion of Britain, had some tin mines in their own country, and being hardy mariners they traded also with their cousins across the water, the voyage being aided by favorable winds and the use of the Channel islands for convenient anchorage. The Romans did not exploit the tin resources of Cornwall, probably, before the third century A.D., and the industry languished until much later, in the thirteenth century, when the tin was produced largely for the making of brass cannons and church bells, an excellent example of the manner in which, ever since the dawn, the metals have been used alternately for maleficent and beneficent purposes, the struggle of advancing civilization being checked recurrently by the savagery of war, which is the very negation of man's constant effort to live intelligently and comfortably.

Then in Mr. Jenkin's book we come to "the tinners under the Stannaries," these being the local courts established in the west country for the settlement of disputes between the tin miners and for the adjudication of differences with outsiders. The miners, and others engaged in the tin industry, became a distinct community, which at one time had even a parliament; but, what was more important, they were exempt from ordinary taxation and also from military services, because the King and his nobles realized the importance to the realm of a vigorous production of the necessary metal. The miner was coddled, there is no doubt, and, in consequence, at times he made himself a nuisance by digging his holes in all sorts of places and cutting wood wherever he pleased. Mr. Jenkin has an interesting chapter, full of archaeological information well substantiated by accurate references, on the "Streamers and Blowers," the former being the alluvial miners and the latter the tin smelters of the "old county." Please note, Mr. Proofreader, that this is "county," not "country"; it has been my fate to find the phrase corrected repeatedly in the belief that "county" was an error.

"THE OLD COUNTY"

The Cornish, "one and all," speak of Cornwall as "the old county." Apropos of this, it is amusing to note, as Mr. Jenkin does, how strong was the local or provincial feeling in former days, when the tin miners were jealous of interlopers or outlanders. At one time, it was ruled that "if any Briton, Frenchman, stranger, alien, etc., search, dig, or mine for tin," he was to forfeit the tin he "raised" and was to be "committed to Launceston gaol." Note that the "Briton" is grouped with the "Frenchman." A later complaint that "furriners" were hired to work at the mines did not refer to Italians or Germans, but only to those that came from a neighboring county or, at most, from Ireland. However, the German miners came in the fifteenth century and they showed the Cornishman a trick or two; at that time the miners of the Harz and the Erzgebirge were the most expert in Europe, and for that reason they were brought to England by Elizabeth and James I. The stamps, for crushing ore, were introduced by a German "mineral man" in 1580, and many are the English mining terms, such as stope, sump, stull, sollar, that commemorate this early contact between the leading miners of the late medieval period. The Cousin Jack appears to have profited from this contact, for soon he became recognized as the most expert of his craft, in consequence of which he was called to all parts of the world during the eighteenth and nineteenth centuries. Mr. Jenkin tells some interesting stories of the "exodus," which took the Cousin Jack to the arctic snows and the tropic deserts, to wherever the brothers of the pick and gad adventured in search of metal and mineral. Reverting to the German irruption into Cornwall, it is amusing to state that, as Pryce relates in his "Mineralogia Cornubiensis," "a tinner, in the time of Richard, Earl of Cornwall and King of the Romans, upon some disgust at home, went over to Saxony, and taught the natives to seek for tin, and render it merchantable." The "disgust at home," according to Matthew Prior, a Benedictine monk of English birth, was the committing of a murder, which compelled the miner to flee from his own country.

Visitors to Cornwall may have noticed holes in the cliffs by the sea and rock arches of a picturesque character, which add to the charm of the scenery. These are the marks of early cliff mining. Says Mr. Jenkin: "In some places, like the Droskyn lode at Perranporth, tall, graceful arches have been left by the removal of the mineral ground; in others, especially near St. Agnes, the cliffs resemble the section of a rabbit warren, being crossed and re-crossed with a labyrinth of little tunnels." Another relic of former days is the "coffin," or open trench, sometimes enlarged to a long open-cut, in which the old men gophered for the tin. These now are the haunts of owls, and the subject of quaint, even fearsome, tales. Another picturesque touch is given by the Levant and Botallack mines, which have engine houses on the edge of the cliffs and workings that extend far underneath the Atlantic waves. Behind is the bleak moor. "Through the cold blustering nights of winter, with the beating pitiless rain, and in the misty nights of autumn, when the air was so still that the creak of the flat rods and the rattle of chains could be heard a mile away, the miners came and went to their labors." The unearthly sounds were those made by the old-fashioned pumping machinery. "It was at times like this," adds our author, "that the miner's wife would sit listening for each step, a candle burning dimly in the cottage window long after the rest of the population was wrapped in darkness and sleep. Often in the darkest nights of winter, in a blustering gale, women would be out on the cliffs with lanterns, waiting for their husbands to come up."

We identify Cornwall with tin both in ancient and modern days, but it is noteworthy that the regional output of copper at one time was such that it represented three-quarters of the world's production. That copper era in Cornwall reached its zenith in about 1860. Copper ore had been mined on a small scale in the sixteenth century, but its value was not appreciated until some time after. In 1787 the number of workers employed in the Cornish copper mines reached seven thousand. The smelting of the ore was done in South Wales, where coal was available for the purpose. The copper orebodies unfortunately proved non-persistent at about a thousand feet from the surface, and by 1870 that branch of the regional

mining industry was dead; but by further exploration it was ascertained that the lodes became tin-bearing at increased depth, so that the Dolcoath mine, for example, after paying $5,000,000 in profit on copper, has paid as much more by the exploitation of its tin resources. Hence Mr. Jenkin, naturally, if not convincingly, argues that Cornwall offers great chances in places where the possibility of finding copper under the tin have not as yet been tested. It is typical of the necessary optimism of the miner that Mr. Jenkin should speak of tin mining in many districts of Cornwall as being "still in its infancy," and that, if you please, after experienced diggers have been rummaging and gleaning in its veins and lodes for two thousand years!

Difficult Conditions

In the two chapters entitled "The Miner at Work" and "The Miner at Home" our author describes the conditions, difficult and discouraging, amid which the Cornishman lived in the period 1800-1870. Other men in other industries in England, and elsewhere, at that time, lived and died with but a slim chance of their normal share of happiness. Poorly paid, badly nourished, and working in unhealthful places, the Cornish miners did their part, and more than their part, in providing the modern world with the metals on which our machine-made civilization is reared. Mr. Jenkin has reinforced his own knowledge with a studious examination of trustworthy evidence gathered by others, so that he gives us sundry pictures the accuracy of which is unimpeachable. The sad recital is lightened with an occasional story in old-fashioned speech and is suffused throughout with an understanding sympathy for the "bal" girls on the dressing floors, the boys that drove the whim horses, the single-handed St. Juster and the kindly old "capun," or captain, the superintendent who wore a white drill coat and a high pole-hat, and gave his nephew a good "pitch" when he became a tributer.

The depressed condition of Cornish mining in the early 'seventies of the last century caused a great exodus to foreign parts. The emigration began in 1778, when men from Redruth went to the Lake Superior copper mines; in 1816, a number of them went with Richard Trevithick to Peru; in 1830, a group of St. Just men migrated to Cuba, and in 1838, under John Taylor & Sons, a large contingent went to Mexico, where some of their names are perpetuated by men and women unable to speak English, but as surely linked with Cornwall as the "Sweet William," the wallflowers, and the pansies that survive in the old gardens under the battlemented walls of Pachuca and Guanajuato.

The gold rushes to California and Australia depleted the mining population of Cornwall still further in the decade 1849-1859. Harry Pascoe is quoted by Mr. Jenkin effectively in a description of the departure of a young adventurer: "And so in the pride of life and with his twenty-first birthday the event of yesterday, he turned his back on the little whitewashed cottage with the geraniums in the window—leaving his mother in a silent and strangely empty room—and keeping a stiff upper lip as he gripped the old man's hand and went off to the unknown future." In foreign lands they built up a "greater Cornwall": at Grass Valley and Nevada City, at Blackhawk and Central City, at Calumet and Houghton, at Ballarat and Bendigo, at El Callao and Potosi, at Barberton and Johannesburg. On the Rand many years ago there used to be a place in the middle of the tents and corrugated shanties that was named "Cousin Jack's Corner" because the Cornish miners used to forgather there of a Saturday night. "A fine spirit of camaraderie existed among the picked Cornishmen who were to be found in the mining camps of those days," says Mr. Jenkin. They held together when the Irish, and then the Finns, and after them the Serbians and Montenegrins began to compete with them. The Cornish were good hammersmen and they had an inherited instinct for finding ore, but the machine era proved too much for them; they were better underground than on surface; the scientific methods of later days found them unprepared, and so they lost their leadership. Today in our country they have taken to other pursuits, leaving their places to Mexicans, Spaniards, and Greeks. The Cousin Jack era is gone, but his tradition remains as an essential part of the story of mining, and it is well that it should be set forth in a book so sympathetic, well-informed, and well written as that of Mr. Jenkin. He has achieved his purpose.

T. A. R.

Dust in Mine Air—The February issue of the *Journal* of the South African Institution of Engineers contains an 18-page article on "The Estimation of Dust in Mine Air on the Witwatersrand" by James Boyd. This study has been made in relation to the prevention of miner's phthisis. In conclusion the author states that dust sampling on the Witwatersrand has had a wonderful effect on dust conditions; that when one compares the average of over 5 mg. per cubic meter in 1914 with the average today of approximately 1 mg., it is obvious that conditions have vastly improved.

Geology, South Africa — Reprints of four articles contained in the December issue of the *South African Journal of Science* have been received. They are respectively as follows: "Some Problems in Rhodesian Physical Geology," by H. B. Maufe; "Some Observations on the Upper Karroo Lavas and Later Sediments of the Gwai Native Reserve, Southern Rhodesia," by S. C. Morgan; "The Problem of the Precambrian Atmosphere," by A. M. Macgregor; and "Observations on the Shabani Chrysotile Asbestos Deposits," by F. E. Keep.

British Guiana—The mining laws of British Guiana are set forth in a 184-page book just issued by the Imperial Institute, London. This constitutes Vol. 9 of "The Mining Laws of the British Empire and of Foreign Countries." The price is 10s. 6d. net at H. M. Stationery Office, Adastral House, Kingsway, London, W.C. 2. The book may also be obtained through the British Library of Information, 5 East 45th St., New York, the price here being $2.80.

Copper-Nickel, South Africa—A one-page article in the *South African Mining and Engineering Journal* for Feb. 18 states that the copper-nickel deposits of the Insizwa range are attracting the attention of capital. A government report on the district, written some years ago, points out the remarkable analogy of the deposits to those at Sudbury, Ont.

Zinc, Coley Process—In the March *Bulletin* of the Institution of Mining and Metallurgy, H. Edwin Coley replies to the discussion on his paper entitled "A Process for the Extraction of Zinc and Other Metals from Ores," which he had presented before the Institution on Jan. 19. Concluding, he asserts that his process and his plant are completely successful.

Rock-Bursts — The March *Mining Magazine* also contains a six-page article on "Rock-Bursts" by Bernard Beringer. Rock-bursts are also known as air-blasts and as pressure-bursts. In this article the author discusses their cause and states what he considers to be the most satisfactory manner of controlling excavations so as to avoid these occurrences.

Lead-Zinc, China—The *Far Eastern Review* for February contains a report on the Shiu Kou Shan lead and zinc mine, Hunan, China. The authors are C. C. Liu, C. C. Tien, and C. Y. Ou Yang. This article appeared originally in the bulletin of the Geological Survey of Hunan, at Changsha, China. Five pages, illustrated.

Spain, Mineral Statistics—Mineral statistics of Spain for 1926 are given in the latest report of the Consejo de Minería at Madrid. The volume, which comprises 750 pages, is entitled "Estadistica Minera de España." A wealth of information regarding the mining industry of Spain is given.

Filtering Oil—*The Mining Magazine* for March contains a seven-page article entitled "Stream-Line Oil Filters and Separators," by J. A. Pickard. The author has endeavored to indicate the possibilities which this new medium possesses for dealing with various problems.

Tin—The March issue of *The Mining Magazine* also contains a five-page article entitled "A New Sluice-Box for Tin Saving," by C. Raeburn, of the Geological Survey of Nigeria. In this the author describes a new form of sluice-box known as the "rocking concentrator."

Geology, Finland—Bulletin No. 79 of the Geological Commission of Finland, Helsingfors, is entitled, in German, "Studien über den Gesteinsaufbau der Kittilä-Lappmark." The author is Victor Hackman. Pages 106.

Personal Notes

HENDON CHUBB has been elected a director of St. Joseph Lead in place of the late J. H. SMITH.

KUNO B. HEBERLEIN, of London, will arrive in New York on April 23 for a short stay in the United States.

ERNEST HARMS, consulting metallurgist of Los Angeles, is spending a few weeks in New York.

PAUL BILLINGSLEY, consulting geologist, has returned to his Salt Lake City headquarters after a brief visit in the East.

PROF. L. C. GRATON, of Harvard University, is now on the Rand studying mining problems in the deep-level mines.

C. W. NICOLSON has left Ishpeming, Mich., for Alaska, where he will take charge of exploratory work for the Washigan Mining Company.

THOMAS LAMONT has been elected a director of the U. S. Steel Corporation to fill the vacancy caused by the death of Elbert H. Gary.

IRA B. JORALEMON, consulting engineer of Ohio Copper, after examining the company's Bingham property, has proceeded to Havana, Cuba.

J. LESLIE MENNELL has established a consulting practice in Toronto and has opened an office in the Federal Building, 85 Richmond St., in that city.

W. A. BROOKS recently resigned from Berta Mining to become manager of the Gibraltar Compañia Minera, situated at Naica, Chihuahua, Mexico.

N. H. JENSEN, mining engineer, of the International Smelting Company, is making a trip through the Southwest in the interests of the company.

DUNCAN SMITH has left Brussels for East Africa, where he will examine gold and tin prospects for a French-Belgian group. He expects to be gone about six months.

DR. A. P. COLEMAN, professor of geology at the University of Toronto, has been awarded the Favelle Medal for scientific research by the Royal Society of Canada.

GEORGE C. CRANGLE has returned to his home at Butte, Mont., after an absence of four years as head of the metallurgical department of South American Gold & Platinum, operating in Colombia.

D. C. DERINGER, until recently mill superintendent for the Mazapil Copper Corporation, Zacatecas, Mexico, has accepted a position with the British Metal Corporation, at Notre Dame d'Ange, Province of Quebec, Canada.

W. W. WISHON, California mining engineer, has returned to Los Angeles from Lordsburg, N. M., where he examined the properties known as the Waldo group for the Southern Metal Company, of New York City.

R. E. PALMER, J. S. DANE, JAMES HOCKING, and R. K. STOCKWELL visited the property of the Tigon Mining & Finance Corporation near Almeria, Spain, recently. Mr. Hocking was recently appointed manager of the property.

H. J. C. CONOLLY, government geologist of British Guiana, is making a trip through the Canadian mining districts. Mr. Conolly is of British birth and education. He graduated from the Royal School of Mines, London, in 1922. From then till 1924 he

H. J. C. CONOLLY

worked in the mill, smelter, and refinery of the Burma Corporation. He then went to British Guiana as the head of the geological survey. The survey has explored and mapped a considerable area in the vicinity of the Pakaraima Mountains, the principal commercial products of which are gold and diamonds. Mr. Conolly considers that British Guiana mining can accomplish most in the dredging and hydraulicking of extensive surficial gold deposits and in the development of its bauxite resources. There is also scope and need for organized methods in the diamond industry.

IMER PETT, general manager of the Bingham Mines Company, Salt Lake City, has returned to his offices in that city from a two weeks' trip to Washington, New York, and Boston, where he conferred with officials of the company.

J. G. BARAGWANATH, mining engineer, has resigned his position as resident engineer at New York of the American Smelting & Refining Company, and has entered private practice. His office is at 52 Vanderbilt Ave., New York City.

SIR ALFRED MOND has been awarded the gold medal of the Institution of Mining and Metallurgy "in recognition of his scientific and industrial services in the development of the mineral resources and metallurgical industries of the British Empire."

E. A. CAPPELEN SMITH, president of the Anglo-Chilean Consolidated Nitrate Corporation, married Señorita Carmen Muñoz Arlequi, of Valparaiso, Chile, on April 13.

PERCY W. SHERWELL, manager of the City Deep mine, on the Rand, for more than fifteen years, has resigned. He will become associated with a South African industrial undertaking. A. V. LANGE, of the staff of Nourse Mines, will succeed Mr. Sherwell.

LE ROY SALSICH, assistant manager of the mines in the Hibbing (Minn.) district of the Oliver Iron Mining Company, has been appointed assistant to W. J. Olcott, president of the company. Mr. Salsich has been connected with the Oliver company since 1901.

RUSSELL S. KNAPPEN, of the Gypsy Oil Company, recently delivered an address to students of mining engineering and geology at the University of Kansas on the subject of geophysical prospecting. The various devices used were outlined and an account was given of the practical results of geophysical prospecting.

PROF. E. S. BIELER, of McGill University, Montreal, has been named deputy director of an experimental geophysical survey in Australia to increase ore reserves which is being organized by the Australian Government and the Imperial Marketing Board. The survey will extend over a period of two years, and Professor Bieler has been granted a leave of absence from McGill to undertake this work. The survey has as its purpose the improvement of the Australian mining situation and the providing for immigration of British miners. BROUGHTON EDGE, an Englishman, has been appointed director of survey. Professor Bieler worked last summer in the Rouyn district of northwestern Quebec. The work of survey in Australia is to start on the known regions of the Kalgoorlie district in the western part of the continent and will proceed in consultation with the Australian geological survey. The purpose is to ascertain which of the physical methods of finding ore are best adapted to Australian conditions. Professor Bieler will sail soon for London and will report there to the authorities at Australia House.

OBITUARY

SAMUEL HOAR, well known in Lake Superior mining fields and the inventor of the Hoar underground loader, died at his home in Virginia, Minn., on April 6. He was 70 years old.

JOHN FREDERICK RUTHERFORD died in Durban, Natal, early in March. He was born in Natal and went to the Witwatersrand in the early days. For more than 30 years he was connected with the Barnato interests. At first he was the mine secretary at the Glencairn. He later joined the Johannesburg Consolidated Investment Company, Ltd., and became a director in many of that company's enterprises. He retired about seven years ago, and made his home at Durban.

Market and Financial News

Curtailment Necessary to Rectify Zinc Situation

By International Metal Service
Foreign Correspondent of American Zinc Institute

With the passing of the first quarter it is perhaps opportune to pause and take stock of things in general with a view to sizing up prospects for the rest of the year.

During 1927 consumption lagged behind production, the latter figuring out at 1,332,200 metric tons and consumption at 1,319,700 metric tons. Now, in the three months just ended, world stocks of refined zinc have risen from 56,100 tons on Jan., 1928, to 62,900 metric tons on March 31, 1928. This rather suggests that either output is further expanding or that consumption is not maintained at the same high level as last year. But in this instance it so happens that there has been no retrogression in world consumption, so that it is necessary to concede that production is continuing to slightly outstrip the world's consumptive needs. At this stage we had better explain that several Continental zinc people do not see eye to eye with us in this connection: yet there is no denying the evidence of carefully compiled statistics.

Granted that consumption in the first three months equaled the average quarterly deliveries in 1927, then it is clear that there is plenty of time for the situation to gather strength before the year end. Rectification can best be provided by voluntary curtailment of output; thus it is decidedly encouraging to note the reduction in retorts in operation in the U. S. from 77,084 on Jan. 1, 1928, to 71,252 at the end of the first quarter. In Europe, on the other hand, production continues to expand, albeit very slowly.

There has been a noticeable resistance to the price of slab zinc in Europe remaining at under £25 per ton; consequently this figure has rightly or wrongly come to be accepted as a low-water mark. The European ore producer and not the European smelter is suffering today, as the returning charge quoted by smelters covers a very fair profit. Hence the prospects for an advance in the selling price of zinc are more dependent upon the course of the market in lead, copper, and tin than on any other cause. Probably there will not be any wide fluctuation in daily quotations on the London Metal Exchange until the second half of the year, in which period we confidently look for a rise in the price of lead, and this should bring about a sympathetic improvement in the zinc market.

The average gain in world consumption of zinc in the past four years has been 90,000 metric tons annually. Assuming this to be a normal yearly increase in consumption, it would mean that the world would call for a production of no less than 1,750,000 metric tons by 1932. This figure may appear absurdly high at this juncture, yet it will be attained if the experience of the last four years be repeated.

Our estimate of world stocks of zinc on April 1, 1928, is as follows:

	Metric Tons
United States	37,700
Canada	4,000
Germany-Poland	6,600
Belgium	5,600
France	1,200
Great Britain	1,300
Scandinavia	200
Australia (including afloat)	3,500
Far East	800
Elsewhere	2,000
Total	62,900

Patino Mines Enjoys Prosperous Year in 1927

Patino Mines & Enterprises Consolidated, Inc., operating tin properties in Bolivia, shows a net income for 1927 of $4,800,071, an increase over the $4,286,085 reported in 1926. In 1927, 300,411 metric tons of ore, containing 4.97 per cent tin, was concentrated, which compares with 232,921 metric tons, analyzing 5.67 per cent tin, in 1926; 17,497 metric tons of concentrate assaying 64.69 per cent tin was produced for export in 1927, against 15,367 metric tons of 59.4 per cent tin material in 1926.

Income Account for 1927 and 1926

Income from mine operations	1927	1926
Sales	$9,227,372	$7,594,589
Interest	119,012	111,413
Exchange	50,133	53,217
Sundries	85,709	202,371
Inventory tin concentrates	6,332,864	6,106,481
Total	$15,815,091	$14,068,073
Total all costs	8,840,406	7,722,331
Profit from mines before charging depreciation	$6,974,685	$6,345,741
Add profit from railroad	396,311	201,613
Total	$7,370,996	$6,547,354
Less interest accrued purchase railroad	143,455	194,414
Balance	$7,227,541	$6,352,940
Less provisions for Bolivian profit tax	562,660	451,980
	$6,664,880	$5,900,960
Less reserves for depreciation and depletion	1,864,809	1,614,875
Net profit	$4,800,071	$4,286,085

Consolidated M. & S. Earnings Held Up Well in 1927

Consolidated Mining & Smelting Company of Canada reports net profits of $13,139,957 in 1927, compared with $13,915,262 in 1926. In the face of low metal prices, earnings were maintained by increased production and reduction in operating costs. Capital expenditure amounting to $3,590,507 was added to the reserve for additions to property through profit and loss in 1927, compared with $2,274,772 in 1926. An additional $1,000,000 was also added to the contingent reserve fund. Capital expenditure amounting to $4,877,019 was spent, of which the more important items were as follows:

Property	
Purchase of shares of Henry Gardner & Company, Ltd.	$486,512
Purchase of shares of West Kootenay Power & Light Company, Ltd.	800,000
Advance to Coast Copper Company	111,534
Sullivan mineral claims	62,608
Big Missouri development	75,760
Buena Vista Mining Company (operating the Big Missouri property)	50,500
Plant	
Smelter extensions	$2,529,354
Sullivan mine and mill additions	557,281
St. Eugene crushing plant	60,982

In the property expenditure the two items of $486,512, paid for 100,000 shares of Henry Gardner & Company, Ltd., and $800,000, paid for shares of the West Kootenay Power & Light Company, Ltd., were added to assets. The remainder of the property expenditure and all of the plant expenditure were changed to operating revenue, and added to "Additions to property through profit and loss."

Profit-and-Loss Account for the Year Ended Dec. 31, 1927

Sales of smelter products, ore	$31,438,566
Ores, metals and smelter product on hand and in transit at Dec. 31, 1927	4,309,160
Revenue from investments and sundry advances	743,119
Rents, royalties and sundry revenue	33,322
Total	$36,524,170
Expenditures	
Ores, metals and smelter product on hand and in transit at Dec. 31, 1926	$4,836,183
Customs ore and bullion purchased	3,421,206
Freight and insurance on ores from company's mines	762,454
Mining, smelting, and general expenses	11,572,064
Development expense	546,877
Depreciation of plant and equipment	1,565,835
Provision for depletion of mineral properties	535,249
Interest, bank and general	68,533
Directors' fees	6,360
Fire insurance reserve	62,993
Sundry items written off	6,454
Balance, profit before provision for dominion and provincial income taxes	13,139,957
Total	$36,524,169

Tonnage treated and metal production at the Kimberley and Tadanac plants, for the period 1894 to date, and for the year 1927:

Production	1894 to Date	Year 1927
Ore, tons	12,590,450	1,405,872
Gold, ounces	2,164,416	29,490
Silver, ounces	61,690,374	7,179,607
Lead, pounds	1,769,198,895	291,043,120
Copper, pounds	142,735,018	18,522,742
Zinc, pounds	709,891,987	147,054,623

Customs ore business at Trail decreased from $4,349,582 in 1926 to $3,421,206 in 1927, largely the result of the lower prices for the major nonferrous metals that prevailed during 1927.

Low Metal Prices Reduce U. S. Smelting Earnings Slightly in 1927

United States Smelting, Refining & Mining Company reports net profits, after depreciation and depletion, of $3,031,328 in 1927, against $3,039,164 in 1926.

Consolidated Profit-and-Loss Account

Earnings, after operating costs, selling expenses and taxes	$5,833,024
Less interest on funded debt	445,893
Net earnings	$5,387,131
Less reserves for depreciation, depletion and amortisation	2,355,803
Profits for 1927	$3,031,328
Surplus at end of 1926	17,529,042
	$20,560,370
Less dividends in 1927	2,931,127
Profit-and-loss surplus, Dec. 31, 1927	$17,629,243

Additions to the property and investment accounts were as follows:

Investments in Alaska	$4,499,504
Addition to plants, equipment and misc.	691,792
Total	$5,191,296

Investments in Alaska represent expenditures for power plant, transmission lines, new dredges for the Fairbanks fields, and payments against placer claims and other property in the Fairbanks and Nome fields.

The construction and development program in the Fairbanks fields is nearing completion, and it is expected that dredging operations will start before the end of the 1928 season.

At the Bingham mines of the company, 201,699 tons of ore was extracted, compared with 197,428 tons in 1926. The Midvale flotation plant operated at capacity throughout the year.

The Loreto and Guerrero mills of the Compañia de Real del Monte y Pachuca treated 1,263,631 metric tons. The grade was lower than in 1926, but the tonnage was larger than that produced in any other year.

Exploration work is being energetically carried out in properties owned or controlled by the company and in adjacent territory. The lower metal prices prevailing in 1927 adversely affected earnings from the various properties; but this was partly offset by reducing working costs, effected in large measure through the skill and co-operation of the various departments and operating staffs.

Calumet & Arizona Earnings Higher in 1927

Calumet & Arizona Mining Company reports net income of $3,725,596, before depletion, in 1927, compared with $3,593,951 in 1926. This company operates its own mines in the Bisbee district, owns nearly 70 per cent of New Cornelia, and is financially interested in other properties. In 1927, 477,771 tons of direct-smelting ore was shipped from the Warren mines to the company's smelter at Douglas, of an average grade of 4.95 per cent copper. About 89,000 tons of ore was shipped from the 85 Mine, at Valedon, averaging 2.33 per cent copper.

Net current and working assets totaled $7,238,716, according to the balance sheet of Dec. 31, 1927. Current liabilities were only 757,490.

Profit and Loss Account

Income

Total earnings on metals	$7,664,822	
Income from dividends	2,550,191	
Interest	119,773	
Other income	581,781	
		$10,916,569

Expenditures

Operating expenses	$4,916,943	
Salaries, office, and general expenses	222,461	
Freight, refining and marketing	965,483	
Taxes	546,217	$6,651,106
Balance		$4,265,462
Less:		
Depreciation	$445,818	
Expenses at outside properties	94,047	$539,866
Net income		$3,725,596

Production

	Copper, Pounds	Silver, Ounces	Gold, Ounces
From domestic ores treated	48,134,598	1,013,976	33,509.2
From domestic ores sold	29,485	1,474	46.5
	48,164,083	1,015,450	33,557.7
From purchased ores.	648,904	36,359	719.0
Totals	48,812,987	1,051,809	34,274.7

In addition, 102 tons of lead ore. 2,063 tons of lead-zinc ore, 1,226 tons of iron flux, and 440 tons of manganese ore were sold and shipped to other metallurgical plants.

Homestake Earnings Improve in 1927

The Homestake Mining Company earned $1,407,542 after all deduction in 1927, which compares favorably with $559,320 earned in 1926. On 251,160 shares of stock outstanding this amounts to $5.60 per share in 1927 and $2.22 in 1926. The company mined 1,317,583 tons of ore during the year, with an average recovery of $4.87 per ton. Mining and milling operations were continuous throughout the year. Detailed statement of operations for the year ending Dec. 31, 1927, follows:

Operating Revenue

Bullion		
Proceeds of bars 6736-6981	$6,679,802	
Wolframite ore operation	15,300	
Wyodak coal operation	35,352	
Interest and rents	96,861	$6,827,316

Operating Expenses

Mining, hoisting and primary crushing	$2,363,004	
Tramming	43,283	
Milling	611,086	
Freight on bullion	7,611	
Golden Gate timber operation	74,881	
Hospital	60,581	
Workmen's disability compensation	21,313	
Employees' welfare—		
Aid fund	$2,172	
Benefices	7,903	
Pensions	38,869	
Recreation hall	26,517	
	75,462	
Taxes	536,906	
Insurance	19,633	
Salaries, office, legal and general expense	191,091	4,004,855
Income		$2,822,461
Charges against income		
Reserved for depreciation and depletion		1,414,918
Net income		$1,407,542

Dividends for the Year

Paid from net income for year, as above	$1,407,542
Paid from depletion reserve	350,577
Total for year	$1,758,120

Nevada Consolidated Earned $5,743,729 in 1927, Before Depletion

The Nevada Consolidated Mining Company, with properties in Nevada, Arizona, and New Mexico, produced 218,683,930 lb. of copper during 1927, which was sold at an average price of 13.077c. per pound. Production of silver was 210,350 oz. and average price received was 56.126c. per ounce. Gold production was 43,052 oz. Income accounts for 1927 and 1926 are compared in the following table:

	1927	1926
Gross revenue	$29,598,751	$33,003,684
Operating expenses	22,219,161	24,446,758
Operating profit	$7,379,590	$8,556,926
Other income	954,009	865,541
Total income	$8,333,599	$9,422,467
Interest	388,066	775,617
Federal taxes	295,056	.....
Depreciation	1,906,748	1,814,455
(a) Net profit	$5,743,729	$6,832,395
Dividends	7,139,013	5,153,606
(a) Deficit	$1,395,284	(b) $1,678,789
Profit-and-loss surplus	12,574,943	14,948,749

(a) Before depletion. (b) Surplus.

Expenditures for improvements at the various properties totaled $1,745,482. Ore reserves were decreased by 2,203,344 tons during the year. Average grade of the 277,483,097 tons of ore reserves on Dec. 31, 1927, was 1.53 per cent copper. Average grade of all ores milled was 1.326 per cent copper and the average recovery was 87.9 per cent. Concentrates produced were of higher grade and a large saving in smelting costs resulted.

Dome Mines Reports Higher Earnings in 1927

Dome Mines, Ltd., operating in the Porcupine district of Ontario, reports net profits of $1,516,338, after depreciation and other charges equivalent to $1.59 per share in 1927, against 1,342,037, or $1.40 per share, in 1926. The tonnage milled was 543,300 tons, of average assay value, $7.71 per ton. Over-all recovery was 96.23 per cent. Operating costs were $4.062 per ton.

Statement of Earnings for 1927

Earnings		
Amalgamation bullion		$2,530,171
Cyanidation bullion		1,501,572
		$4,031,744
Non-operating revenue		211,936
		$4,243,680

Operating and Maintenance Expenditure

Mining, inluding hoisting	$670,201	
Development	686,485	
Crushing and conveying	81,015	
Milling	519,283	
Bullion expense	21,801	
Fire protection	7,624	
Warehouse expense	10,739	
Auditor's expense	2,708	
Administrative expense—mine office	95,925	
Administrative expense—executive office	20,580	
Provincial and municipal taxes	65,649	
Insurance	25,121	
Total	$2,207,136	
Reserve for Dominion of Canada and U. S. income tax	75,959	
		2,283,096
Profit for the year (before depreciation)		$1,960,584

The Market Report

Prices Continue Firm in Dull Metal Markets

New York, April 18, 1928.—Absence of buying interest, accompanied by unchanged or, in some cases, slightly higher prices, featured the non-ferrous metal markets during the week ending today. Offerings of copper at 14.125c. and 14.15c. apparently have been taken up, and 14.175c., Connecticut basis, is the bottom figure today. Primary producers are firm at 14.25c. Lead has been quiet but steady at 6.10c. New York and 6c. St. Louis; some activity is reported in tin at slightly better prices; and the tone of the domestic zinc market is better as a consequence of some improvement in prices in London. Silver is steady and firm, the closing price of 57½c. being an advance of ¼c. during the week. Quicksilver and antimony quotations are fractionally higher.

Daily Prices of Metals

April	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
12	13.925@14.00	51.625	6.10	6.00	5.725
13	13 925@14.025	52.00	6.10	6.00	5.725
14	13.925@14.025	51.875	6.10	6.00	5.725@5.75
16	13.925@14.025	52.25	6.10	6.00	5.75
17	13.95@14.025	52.75	6.10	6.00	5.75
18	13.95@14.025	52.375	6.10	6.00	5.75
	13.977	52.146	6.100	6.00	5.740

Average prices for calendar week ending April 14, 1928, are: Copper, 13.960; Straits tin, 51.938; N. Y. lead, 6.100; St. Louis lead, 5.996; zinc, 5.735; and silver, 57.167.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted, and prices at so-called Middle West destinations, 0.325c. above.

Quotations for copper are for the ordinary form of wire bars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

April	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
12	61⅝	61¾	66½	232	232⅞	20	20 5/16	24 13/16	24 13/16
13	61¾	61¾	66½	230¼	231	20 1/16	20 7/16	25	25
16	61⅝	61 11/16	66½	231½	232⅜	20	20 7/16	25 5/16	25¼
17	61 9/16	61⅝	66½	234⅞	235½	20 1/16	20 7/16	25½	25⅜
18	61⅜	61 11/16	66½	234¾	234⅝	20 5/16	20⅝	25 9/16	25 7/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

April	Sterling Exchange "Checks"	Silver		Gold London	April	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
12	4.87⅞	57⅛	26 5/16	84s11½d	16	4.87 15/16	57¼	26¼	84s11½d
13	4.87⅞	57⅛	26¼	84s11½d	17	4.87 15/16	57⅜	26¼	84s10½d
14	4.87 15/16	57¼	26 5/16	.....	18	4.87 15/16	57½	26⅜	84s10½d
					Avg.		57.271		

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths cent premium.

Copper Producers Still Quote 14.25c.; Sales at 14.175c.

The copper market has drifted into the same position as existed six weeks ago, except that the asking price of producers is 14.25c., Connecticut, instead of 14.125c. Some scattering business is being placed on the basis of this figure, and a fair tonnage is being placed in the so-called Middle West at 14.375c. The metal that was available at 14.125c. a week ago has disappeared, and since Monday the lowest quotation has been 14.175c. In the aggregate, total sales have been small, indeed; and, with the requirements of consumers for May metal provided for to a large extent, the dullness is likely to persist for another week or two. Requests on the part of some users that shipment dates be advanced indicate that current manufacture is on a somewhat larger scale than had been anticipated. So long as fabricators have plenty of orders, primary producers of copper are prepared to wait until they can realize their price, no matter what policy is followed by the smaller interests. Foreign sales at the Exporters' price of 14.50c. c.i.f. have reached about 30,000 tons thus far this month.

Lead Quiet and Unchanged

Very little interest was shown in lead this week, practically none of the large buyers being in the market and most of the sales being confined to carload lots for prompt shipment. Quotations of all sellers reporting were uniform at 6.10c., New York, which is also the contract price of the American Smelting & Refining Company, and 6.00c., St. Louis. In the last day or so there have been rumors that one of the smaller Middle Western producers might sell at 5.975c., but it is probable that little if any lead was actually marketed at that level. The more important sellers show no inclination to shade prices, one of them already being more than sold out of April production. The St. Louis price is within 10 points of the New York quotation, which is an unusually narrow differential, but the stocks of chemical lead do not seem burdensome.

Statistics just issued by the A. B. M. S. show an increase in the U. S. and Mexican stocks of refined lead from 47,598 tons at the end of February to 57,063 at the end of March, following an increase of about 11,000 tons in the month before. Stocks of crude bullion are not yet available, but it is likely that a part of the increase in refined is attributable to a conversion of stocks of bullion. However, in February, total stocks increased 10,000 tons, whereas production decreased 2,000 tons over the month before, so that a real curtailment in consumption seems to be in evidence. March production of crude is higher than in either January or February, so

it would seem that the slightly lower ore production reported from Oklahoma and Utah is offset by increases elsewhere.

Better Tone to Zinc

Renewal of the reports that a cartel agreement was pending among European zinc producing interests presumably is the cause of some hardening in the London market, which, incidentally, has been reflected to some extent in sentiment on this side. This is assigned as a probable reason for the purchase of nearly 21,000 tons of ore in the Joplin district, after several weeks of meager buying. If the curtailed program of mine production is continued, some improvement in the market is likely. Galvanizers have not bought in any quantity this week.

Cheaper Tin Attracts Buyers

When tin was between 51½ and 52c., as it was from the 10th to the 14th, considerable consumer buying was stimulated. In the last three days, with the quotation for prompt Straits again above 52c., most of the buying has been for the account of dealers who look for a somewhat more stringent position in May and June. Forward is ⅜ to ½c. lower than prompt.

Silver Higher

The market continued quiet until the middle of the week, when better rates from India and China improved the tone considerably. Buying from these sources resulted in a gradual rise in quotations, closing steady to firm today at 57½.

Mexican Dollars (Old Mexican pesos): April 12th and 13th, 43¾c.; 14th and 16th, 43⅞c.; 17th, 44c.; 18th, 44⅛c.

Sterling Near Export Point

Sterling was very strong all week, yesterday touching a new high for the year, so that gold exports may soon take place again. Closing cable quotations on Tuesday, April 17, were as follows: Francs, 3.93¾c.; lire, 5.28c.; and marks, 23.91¾c. Canadian dollars, ⅛ per cent premium.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

ALUMINUM—Per lb., 98 or 99 per cent grades, price of leading interest, 24.30c.; outside market, 23.90@24.30c.

ANTIMONY—Per lb., duty paid: New York: Chinese brands, for all positions, 10c. Market stronger.

Cookson's "C" grade, spot, 15⅜c. Needle antimony nominally 7¼c. for lump and 10c. for powdered. White oxide, Chinese, 99 per cent Sb_2O_3, 11¼c.

BISMUTH—Per lb., New York, in ton lots, $2.10. Smaller lots, $2.25 and up.

IRIDIUM—Per oz., $275@$300 for 98@99 per cent sponge and powder. Market dull, prices largely nominal.

NICKEL—Per lb. ingot, 35c.; shot, 36c.; electrolytic, 37c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $46@$49. Small lots bring up to $55. Absolutely no activity in market.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $80. Dealers and refiners quote the trade for refined metal, per oz., cash, $74@$76. Market dull.

QUICKSILVER — Per 76-lb. flask, $123.50@$124.50, depending on quantity. Market firm. San Francisco wires $122.33.

Prices of Cadmium, Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten, and Zirconium are unchanged from the issue of April 7.

Metallic Ores

MANGANESE ORE—Per long ton unit of Mn, c.i.f. North Atlantic ports, minimum 47 per cent Mn: 35@38c. Caucasian, washed, 53@55 per cent, 38@40c. Chemical grades unchanged from quotations in the April 7 issue.

TUNGSTEN ORE—Per unit of WO_3, N. Y.; Wolframite, $10.37½@$10.60. Western scheelite, $10.50@$10.75. Prices nominal.

Chrome, Iron, Tantalum, and Titanium ores are unchanged from quotations in the April 7 issue.

Freer Selling in Joplin Market

Joplin, Mo., April 14, 1928

Blende

High	$41.15
Premium blende, basis 60 per cent zinc	$38.00@ 39.00
Prime Western, basis 60 per cent zinc	38.00
Fines and slimes, 60 per cent zinc	36.00@ 37.00
Average settling price, all zinc	38.56

Galena

High	$78.10
Basis 80 per cent lead	77.50
Average settling price, all lead	75.51

Shipments for the week: Blende, 10,973; lead, 1,876 tons. Value, all ore the week, $564,780.

Buyers found an easier market this week and were enabled to fill orders by noon today. Sales for the last two weeks have been close to 32,000 tons. The sales for the two weeks will take up a third of the reserve tonnage, and apparently leave the market in a healthier condition, as restriction of output is continued.

Platteville, Wis., April 7,1928

Zinc Blende

	Per Ton
Blende, basis 60 per cent	$40.75

Lead Ore

Lead, basis 80 per cent lead	76.00

Shipments for the week: Blende 1,050 tons; lead, 40 tons. Shipments for the year: Blende, 10,425 tons; lead, 600 tons. Shipments for the week to separating plants, 1,441 tons blende.

Platteville, Wis., April 14, 1928

Zinc Blende Per Ton

Blende, basis 60 per cent $40.75

Lead Ore

Lead, basis 80 per cent lead $79.00

Shipments for the week: Blende, 540 tons; lead, 40 tons. Shipments for the year: Blende, 10,965 tons; lead, 640 tons. Shipments for the week to separating plants, 820 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, Tripoli, and Zircon are unchanged from prices in the April 7 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic)—Per lb., 4c. Market quiet.

Calcium Molybdate, Copper Sulphate, Sodium Sulphate (Salt Cake), Sodium Nitrate, and Zinc Oxide are unchanged from prices in the April 7 issue.

Ferro-Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or duty paid, port of entry, $100 quoted for second quarter, 1928. Spiegeleisen, 19@21 per cent, $32 f.o.b. furnace.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent, 92@95c. f.o.b. works.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, and Ferrovanadium are unchanged from prices in the April 7 issue.

Metal Products

Rolled Copper, Lead Sheets, Nickel Silver, and Yellow (Muntz) metal are changed from prices in the April 14 issue.

ZINC SHEETS—9c. per lb., f.o.b. works, effective April 16.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of April 7.

Iron, Steel, and Coke

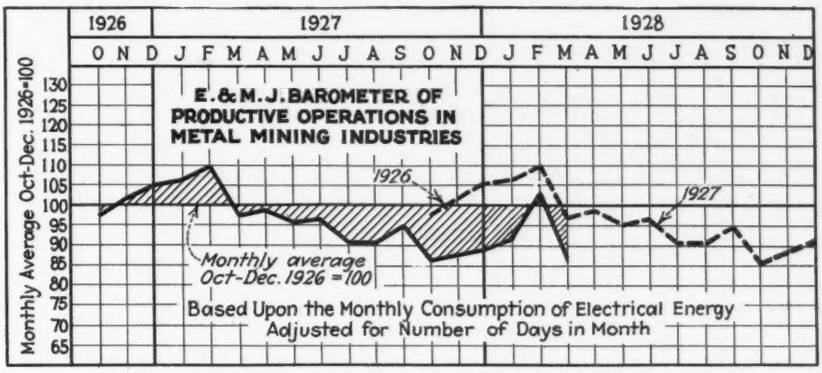
Iron—Per gross ton, Valley furnaces, Bessemer, $17.50; basic, $17; No. 2 foundry, $17.25.

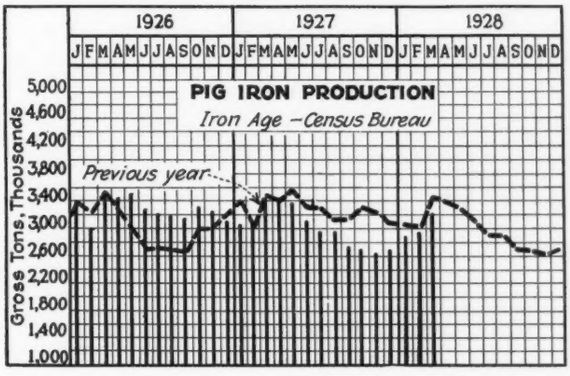
Steel—Base prices per gross ton, Pittsburgh, billets and slabs, $33; plates, structural shapes, and soft steel bars, per pound, 1.85@1.90c.

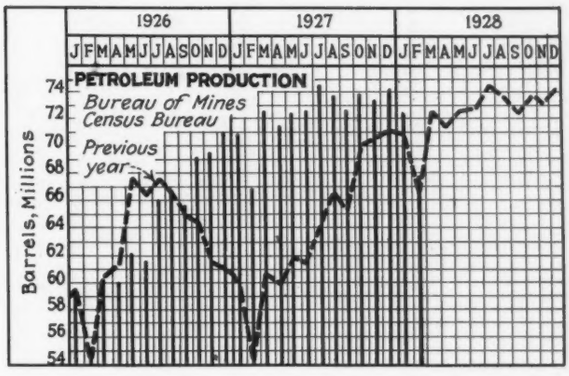
Coke—Per gross ton, Connellsville furnace, contract, $2.75@$3; spot, $2.65@$3. Connellsville foundry, contract, $3.75@$4.25; spot, $3.75@$4.25. By-product coke, Ohio and Kentucky, $7; Buffalo and Detroit, $8.50@$9.

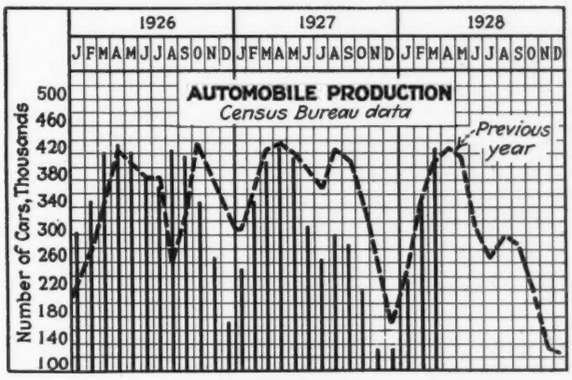
Indicators of Industrial Activity

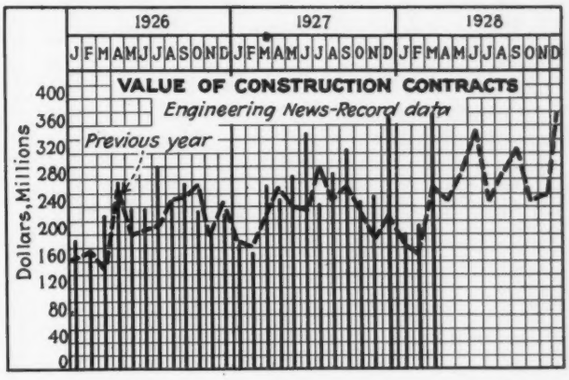
of Significance to Mining

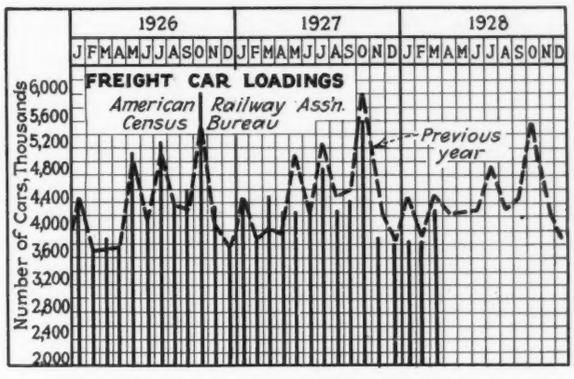

1926
1927
1928
O N D J F M A M J J A S O N D J F M A M J J A S O N D
E. & M. J. BAROMETER OF PRODUCTIVE OPERATIONS IN METAL MINING INDUSTRIES
1926
1927
Monthly average Oct-Dec. 1926 = 100
Based Upon the Monthly Consumption of Electrical Energy Adjusted for Number of Days in Month
Monthly Average Oct-Dec. 1926=100
130 125 120 115 110 105 100 95 90 85 80 75 70 65

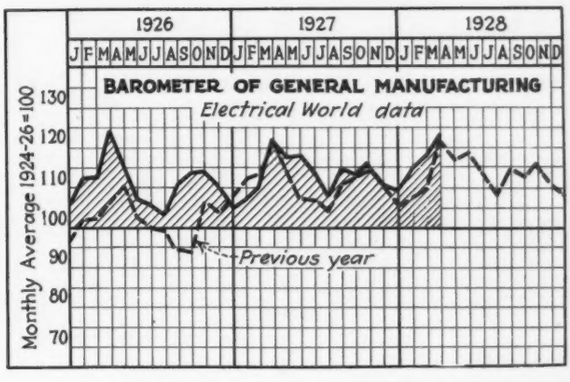

1926
1927
1928
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
PIG IRON PRODUCTION
Iron Age – Census Bureau
Previous year
Gross Tons, Thousands
5,000 4,600 4,200 3,800 3,400 3,000 2,600 2,200 1,800 1,400 1,000


1926
1927
1928
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
PETROLEUM PRODUCTION
Bureau of Mines
Census Bureau
Previous year
Barrels, Millions
74 72 70 68 66 64 62 60 58 56 54


1926
1927
1928
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
AUTOMOBILE PRODUCTION
Census Bureau data
Previous year
Number of Cars, Thousands
500 460 420 380 340 300 260 220 180 140 100


1926
1927
1928
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
VALUE OF CONSTRUCTION CONTRACTS
Engineering News-Record data
Previous year
Dollars, Millions
400 360 320 280 240 200 160 120 80 40 0


1926
1927
1928
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
FREIGHT CAR LOADINGS
American Railway Ass'n. Census Bureau
Previous year
Number of Cars, Thousands
6,000 5,600 5,200 4,800 4,400 4,000 3,600 3,200 2,800 2,400 2,000


1926
1927
1928
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
BAROMETER OF GENERAL MANUFACTURING
Electrical World data
Previous year
Monthly Average 1924-26=100
130 120 110 100 90 80 70

Mining Stocks—Week Ended April 14, 1928

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	72⅞	67⅞	68⅛	Ap.14, My.20 Q	0.75
Ariz. Com'l	Boston	4⅛	4⅛	4⅛	Ja. 19, Ja. 31	0.25
Cal. & Ariz	New York	105½	100½	102		
Calumet & Hecla	Boston	22⅜	21½	21½	No.30, De.15 Q	0.50
Cerro de Pasco	New York	71½	66⅜	70⅜	Ap.12, My.1 Q	1.00
Chile Copper	New York	42⅞	41	42⅜	Ma. 2, Ma.30 Q	0.26
Con. Copper mines	N. Y. Curb	11	9⅜	10⅜		
Copper Range	Boston	17⅜	16½	16½	Ap.2, Ma.2, A	1.00
Crystal Copper	Boston Curb	78	65	78		
East Butte	Boston	2	1⅞	2	Dec., 1919	0.50
Granby Consol	New York	51½	48⅛	48⅛	Ap.13, My.1 Q	1.00
Greene Cananea	New York	136½	125	125⅞	Nov., 1920	0.50
Howe Sound	New York	53⅜	50⅞	52⅛	Ma.31, Ap.16, Q	1.00
Inspiration Consol	New York	24	20	22	Ma.17, Ap.4, Q	0.25
Iron Cap	Boston Curb	2⅞	2⅛	2⅛		
Isle Royale	Boston	15½	13⅛	14⅛	Fe.28, Ma.15	0.50
Kennecott	New York	89½	85	85⅛	De.2, Ja.3 Q	1.25
Magma Copper	New York	51	47⅛	48⅞	Ma.31, Ap.16 Q	0.75
Mason Valley	N. Y. Curb	1⅛	1⅛	1⅛		
Miami Copper	New York	19⅛	19	19⅛	My.1, My.15, Q	0.37½
Mohawk	Boston	65	60½	62	Ja.28, Ma.1 Q	1.00
Montana-Idaho	Spokane	*41½	*39	*39⅜	Ap.30, Jn.1	1.00
Mother Lode Coal	New York	3⅛	3	3⅛	De.16, De.31	0.25
Nevada Consol	New York	22	20⅛	21⅛	Ma.16, Ma.31 Q	0.374
New Cornelia	Boston	29⅛	28	28⅛	Fe.3, Fe.20 Q	0.50
Noranda	N. Y. Curb	19	17⅛	18⅛	My.4, My.21	0.50
North Butte	Boston	2⅜	2	2	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*85	*80	*85	Sept., 1926	0.03
Old Dominion	Boston	11⅜	10⅛	10⅜	Dec., 1918	1.00
Phelps Dodge	N. Y. Curb	132⅜	125½	131	De.17, Ja.3 Q	1.50
Quincy	Boston	13⅜	12⅜	12⅜	March, 1920	1.00
St. Mary's Min. Ld	Boston	26⅜	25½	25⅜	Fe.10, Ma.10	2.00
Seneca Copper	New York	3	2⅛	2⅛		
Shattuck-Denn	N. Y. Curb	18⅜	15	18⅛		
Tenn. C. & C	New York	12	11⅛	11⅜	Fe.29, My.15,Q	0.12½
United Verde Ex	N. Y. Curb	20	19⅜	19⅜	Ap.6, My.1, Q	0.50
Utah Copper	New York	150	150	150	Ma.16, Ma.31 Q	0.50
Utah Metal & T	Boston	1⅜	1⅜	1⅜	Dec., 1917	0.30
Walker Mining	Salt Lake	*98	*79	*97		
NICKEL-COPPER						
Internat. Nickel	New York	93⅞	88⅜	90⅛	Ma.15, Ma.31Q	0.50
Internat. Nickel pfd	New York			113	Ap.12, My.1 Q	1.50
LEAD						
Gladstone Mtn	Spokane	*8⅛	*6	*6	June, 1927	0.005
National Lead	New York	129⅛	129	129	Ma.16, Ma.31Q	1.25
National Lead pfd	New York	147	146½	147	Ap.23, Ma.1 Q	1.50
National Lead,pfd. B	New York	120½	120	120		
St. Joseph Lead	New York	40½	39½	40⅛	Jn.9, Jn.20, QX	0.75
ZINC						
Am. Z. L. & S	New York	30⅜	23½	26	May, 1917	1.00
Am. Z. L. & S. pfd	New York	98	91½	91½	Nov., 1920	1.50
Butte C. & Z	New York	7	5⅞	7	De.9, De.24	0.50
Butte & Superior	New York	11⅛	10½	10⅜	De.16, De.31 Q	0.50
Callahan Zn-Ld	New York	2⅛	2	2⅛	Ma.14, Ma.31	0.50
Consol.Lead&Zinc 'A'	St. Louis	12½	12	12	Ma.15, Ap.1 Q	0.25
Eagle-Picher	Cincinnati	18	16⅜	16⅜	No.15, De.1 Q	0.40
Eagle-Picher pfd	Cincinnati	105	105	105	Jn.30, Oc.15 Q	1.50
New Jersey Zn	N. Y. Curb	199	196	199	Ma.31, Ap.16 Q	1.50
Treadwell-Yukon	Toronto	25.50	23.50	23.50		
United Zinc	N. Y. Curb	..	...	25		
Yellow Pine	Los Angeles	..	..	*25	Dec., 1925 Q	0.04
GOLD						
Alaska Juneau	New York	3⅜	3⅜	3⅜		
Argonaut	Toronto	*17	*6½	*7½		
Barry-Hollinger	Toronto	1.50	1.25	1.28		
Central Manitoba	Toronto	1.40	1.25	1.31		
Con.W.Dome L. new.	Toronto	*10⅜	*9⅜	*9⅜		
Cresson Consol. G	N. Y. Curb	1⅜	1⅛	1⅛	Ma.31, Ap.10 Q	0.10
Dome Mines	New York	11	10½	10⅜	Ma.31, Ap.20 Q	0.25
Golden Cycle	Colo.Springs	†1.72	†1.70	....	Fe.29, Ma.10 Q	0.04
Gold Hill	Toronto	*22	*15	*16		
Hollinger Consol	Toronto	17.00	16.80	16.95	Ap.4, Ap.21	0.10
Homestake Mining	New York	75	72	75	Ap.20, Ap.25 Q	0.50
Kirkland Lake	Toronto	2.02	1.96	1.96		
Lake Shore	Toronto	24.10	23.00	23.25	Ma.1, Ma.15QX	0.20
McIntyre-Porcupine	New York	26½	26½	26½	Fe.1, Ma.1 Q	0.25
Portland	Colo.Springs	†20	†20	....	Ap.6, Ap.15 Q	0.02½
Rand Mines	New York	...	...	40⅜	Au.22-29 Am.Sh.	1.52
Sylvanite	Toronto	3.25	3.15	3.21		
Teck-Hughes	Toronto	9.12	8.75	8.80	Fe. 1, X	0.15
Tom Reed	Los Angeles	*33	*30	*33	Dec., 1926	0.02
Tough-Oakes	Toronto	*57	*51	*52½		
United Eastern	N. Y. Curb	*55	*50	*50	July, 1924	0.05
Vipond Cons	Toronto	*70	*55	*55	Ap.1, Ap.15	0.03
Wright-Hargreaves	Toronto	4.75	4.50	4.50	Ap.13, My.1	0.05
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	25⅛	24⅜	24⅜		
Con. Cortez	N. Y. Curb	*27	*25	*27		
Dolores Esperanza	N. Y. Curb	*58	*40	*58	July, 1923	0.05
N.Y. Hond's Rosario	N. Y. Curb	17	16⅜	17	Ap.18, Ap.28 Q	0.05
Premier Gold	N. Y. Curb	2⅜	2⅛	2⅛	Ma.15, Ap.4	0.08
Tonopah Belmont	N. Y. Curb	...	...	1⅜	Ma.15, Ap.4	0.08
Tonopah Extension	N. Y. Curb	*12	*11	*12	Ma. 1, Ap.21	0.07½
Tonopah Mining	N. Y. Curb	4⅛	4⅛	4⅛	Mar.,31 Ap. 21	0.07½
West End Consol	N. Y. Curb	...	...	*6	Mar., 1923	0.05
Yukon Gold	Boston Curb	*88	*70	*77	June, 1918	0.02
SILVER						
Beaver Consol	Toronto	1.60	1.54	1.60	May, 1920	0.03
Castle-Trethewey	Toronto	*61	*60	*60½		
Coniagas	Toronto	5.50	5.00	5.00	May, 1924	0.12½
Keeley	Toronto	*65	*59½	*65	Ma.1, Ma.15	0.04
Lorrain Trout Lake	Toronto	...	...	*30	July, 1925	0.05
Mining Corp. Can	Toronto	3.50	3.30	3.35	Ja.10, Ja.25	0.15
Nipissing	N. Y. Curb	4⅜	4⅜	4⅜	Ma.31, Ap.20Q	0.07½

Stock	Exch.	High	Low	Last		Last Div.
SILVER-LEAD						
Ahumada	New York	5⅛	4⅜	4⅜	Ma.25, Ap.4QX	0.12½
Bingham Mines	Boston	54	52	52	Ma.22, Ap.5 Q	1.00
Bunker Hill & Sullivan	N. Y. Curb	144⅛	140	140	Ma.31, Ap.4 MX	0.75
Cardiff M. & M	Salt Lake	*74	*68	*74	Feb. 5, 1927	0.10
Chief Consol	Salt Lake	4.07½	3.92½	4.00	Ja.10, Fe.1 Q	0.10
Consti'nMng.&Mill'g.	Spokane	*20	*10	*20		
Erupcion	Boston Curb	...	...	*30	Ap. Q	0.07½
Eureka Lily	Salt Lake	1.80	1.62½	1.67½		
Federal M. & S	New York	130	125	130	Jn.25, Jn.29 Spec.	$10
Federal M. & S. pfd	New York	95	94½	95	Fe.24, Ma.15 Q	1.75
Hecla Mining	N. Y. Curb	16	14⅛	14½	Fe.15, Ma.15 Q	0.25
Highland-Surprise	Spokane	*14	*13	*13½		
Iron King Mining	Salt Lake	*65	*61	*65		
Keystone Mining	Salt Lake	*33½	*31	*32	Au.12, Au.26	0.07½
Lucky Jim	Spokane	*40	*39	*39½		
Lucky Tiger-Com	Kansas City	†7.95	†7.75	..	Ap.10, Ap.20QX	0.07
Mammoth Mining	Salt Lake	1.60	1.50	1.50	Jn.10, Jn.20 Q	0.05
North Lily	Salt Lake	6.60	6.40	6.40		
Park Utah	New York	11⅜	11	11	Ma.15, Ap.15 Q	0.20
Plutus Mining	Salt Lake	†2.25	†1.80	....	Dec., 1927 QX	0.20
Silver King Coal	Salt Lake	11.25	11.00	11.25	Ma.20, Ap.2	0.25
Silversmith	Spokane	*18½	*16	*17	Oct., 1926 Q	0.02
Strattons Mines	Spokane	*47½	*46	*47		
Sunshine M. Co	Spokane	1.40	1.30	1.30	Fe.10, Fe.20	0.02
Tamarack-Custer	Spokane	*97½	*85	*85	Sept., 1924	0.25
Tintic Standard	Salt Lake	14.00	13.62½	13.75	Ma.21, Ma.29Q	0.30
Utah-Apex	Boston	4½	4⅛	4½	Oct., 1926	0.25
IRON						
Bethlehem Steel	New York	69⅞	58½	66½	Se. 2, Oc. 1	1.75
Cleveland-Cliffs Iron	Cleveland	119	114	115	Ap.13, Ap. 25. Q	1.00
Colorado Fuel & Iron	New York	80⅜	73⅜	76	May, 1921	0.75
Gt. North'n Iron Ore	New York	25	21⅛	24½	Dec. 6, Dec. 28	0.75
Inland Steel	New York	55	52	54½	Fe. 15 Ma. 1 QX	0.66¾
Republic I. & S	New York	64½	60	63	Fe. 15, Ma. 1 Q	1.00
Republic I. & S. pfd	New York	108	108	108	Ma. 15, Ap. 2 Q	1.75
Sloss-Sheffield S. & I	New York	125	118½	125	De. 10, De. 20 Q	1.50
Sloss-Snef. S.&I. pfd	New York	...	...	119	De. 20, Ja. 3 Q	1.75
U. S. Steel	New York	154	145⅛	150	No. 30, De. 30 Q	1.75
U. S. Steel, pfd	New York	145⅜	145¼	145⅜	Oc. 30, No. 29 Q	1.75
Virginia I. C. & C	New York	...	...	32	Jan., 1924	1.50
Virginia I.C.&C. pfd	New York	56⅛	56⅜	56⅜	De. 16, Ja. 3	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN						
De Beers Consol	New York	27	27	27	Jn. 26, Jn. 30	1.45
So. Am. G. & P. New	N. Y. Curb	3⅛	3⅛	3⅛		
Alum. Co. of Amer	N. Y. Curb	150	128½	142		
Alum. Co. of Amer. pf.	N. Y. Curb	109½	109	109½	Ma. 15, Ap. 1 Q	1.50
Vanadium Corp	New York	89½	83½	86	Fe. 1, Fe. 15 Q	0.75
Patino M. & E	New York	33	27¼	31½	De. 31, Ja. 14	4s.
ASBESTOS						
Asbestos Corp	Montreal	34	31½	34	Jan., 1926	1.50
Asbestos Corp. pfd	Montreal	94½	92½	93	Ma. 31, Ap. 16 Q	1.75
SULPHUR						
Freeport Texas	New York	85⅜	81⅜	83	Ap.14, Ma.1 QX	1.75
Texas Gulf	New York	78½	73½	76	Ma. 1, Ma. 15 Q	1.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	45⅜	43	44¼	Fe. 18, Ma. 1 Q	0.75
Amer. Metal, pfd	New York	116½	114	116	Fe. 18, Ma. 1 Q	1.75
Amer. Met. & pfd 7%	New York	125	124½	125		
Amer. Sm. & Ref	New York	191½	185	188	Ap.13, My.1 Q	2.00
Amer. Sm. & Ref. pfd	New York	140⅛	140⅛	140⅞	My. 4, Jn. 1 Q	1.75
Consol. M. & S	Montreal	278	270	276	De. 31, Ja. 16 X	6.25
Newmont Mining	N. Y. Curb	173	164⅜	171	Ma.31, Ap.16 Q	1.00
U. S. Sm. R. & M	New York	42⅜	41	41⅞	Ap.5, Ap.14 Q	0.87½
U.S. Sm. R.&M. pfd	New York	54	53	53	Ap.5, Ap.14 Q	0.87½

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. F, four weeks. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

LONDON QUOTATIONS—WEEK ENDED APRIL 3, 1928 Last Div.

Name	High	Low	Last	Date	Amount
Aramayo Mines (25 frs.)	65/—	61/3	63/9	Feb., 1928	5 p.c. (†)
Burma Corpn. (10 rupees)	13/3	12/7½	12/9	Jan., 1928	6 annas*
Bwana M'Kubwa (5s)	5/7½	5/1½	5/4½		
Camp Bird (2s)	5/4½	4/9	5/—	April, 1928	16¾ p.c.
El Oro (£1)	4/4½	4/1½	4/3	Nov., 1924	2½ p.c.*
Frontino & Bolivia (£1)	14/3	13/9	13/9	Jan., 1928	5 p.c.
Mexican Corpn. (£1)	10/6	9/9	10/—		
Mexico Mines of El Oro (£1)	25/7½	21/3	25/—	Dec., 1926	3¾ p.c.*
Mond Nickel	161/3	142/6	151/3	Feb., 1928	7½ p.c.
N'Changa Copper Mining	11/3	11/—	11/3		
Oroville Dredging (£1)	3/9	3/7½	3/9	Dec., 1923	3¾ p.c.
Rhodesian Congo Border (£1)	19/9	16/10½	18/9		
St. John del Rey (£1)	12/4½	12/—	12/3	May, 1927	3¾ p.c.
San Francisco Mines (10s)	28/3	27/7½	27/9	Jan., 1928	25s.
Santa Gertrudis (£1)	16/1½	15/6	15/9	Jan., 1928	7½ p.c.
Selukwe (2s. 6d.)	13/9	10/3	12/7½	April, 1917	6¾ p.c.
S. Amer. Copper (2s.)	1/7	1/4½	1/6	Nov., 1917	75 p.c.
Tanganyika (£1)	68/3	62/3	65/7½	Aug., 1927	7½ p.c.
Union Miniere de Haut-Katanga (Brussels)	8,037.50	7,550	8,050	July, 1927	182.60 (‡)

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian frs. and free of taxation.